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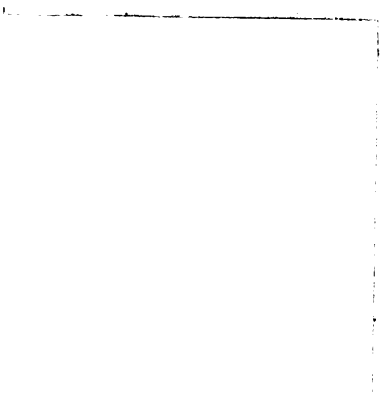

ILLINOIS
STATE GEOLOGICAL SURVEY

BULLETIN NO. 15

Geography of the Middle Illinois Valley

BY

Harlan H. Barrows

Urbana
University of Illinois
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LETTER OF TRANSMITTAL.

STATE GEOLOGICAL SURVEY.
UNIVERSITY OF ILLINOIS, March 22, 1910.

Hon. C. S. Deneen, Chairman, and Members of the Geological Commission:

GENTLEMEN—I submit herewith a report on the Geography of the Middle Illinois Valley, with the recommendation that it be published as Bulletin No. 15 of the Survey. This is the fifth contribution to our series of "Educational Bulletins" prepared under the general direction of Professor R. D. Salisbury, Consulting Geologist of the Survey.

Professor Harlan H. Barrows, the author, has based this report on field work in 1906-07 along the Illinois river between Peoria and Hennepin. He has also drawn on his extended experience at the University of Chicago in teaching and research work on problems of community development as affected by environment. The main physiographic features of this region, which impress all close observers, are first described and interpreted. This is followed by a study of the rocks, including as they do valuable beds of coal, shale, limestone and water-bearing sandstone. Other chapters reveal, in the history of the glacial period, the sequence of events in this area which account for the present physiography. A final chapter of most interesting historical character describes the settlement and development of the Peoria-Hennepin region from the time of the pioneers who emigrated from the South and from New England. The distribution of the early population, its conquest of adverse conditions and final development into a community of great interests, is skillfully traced.

Of timely interest is the history of the Illinois-Michigan canal and the discussion of the conditions which brought about its rise and decline. The Hennepin canal is also described. Finally, the writer reviews the factors affecting the Deep Waterway movement.

General readers and particularly teachers and students residing in the area under discussion will have a clearer understanding of the home region after reading this report and noting its numerous illustrations. But, in addition, all students of Illinois history and of modern geography will find the report extremely helpful.

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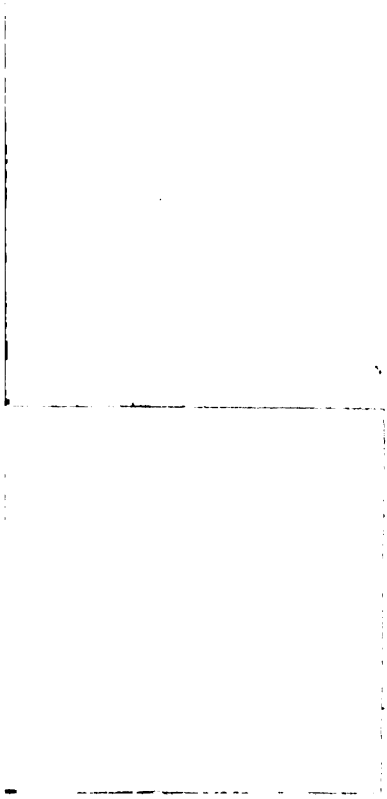

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is approached. Since the terraces are remnants of old flood-plains, they are remnants of flats which originally extended across the valley to the edge of some higher terrace or to the valley wall. Since flood-plains decline down-stream, a given terrace should stand at progressively lower levels down valley.

The terraces are in striking contrast with the present flood-plain, in that they are in many places made uneven by sand hills built upon them and by shallow, steep sided valleys cut into them. Sand hills are especially well developed on the Chillicothe and Pekin terraces. Here they form a complex of irregularly shaped hills and short ridges, often associated with shallow depressions without outlet. In some instances they attain an elevation of thirty to forty or more feet above their immediate surroundings. Since the terraces were originally flood-plains, these features were obviously acquired since their formation.

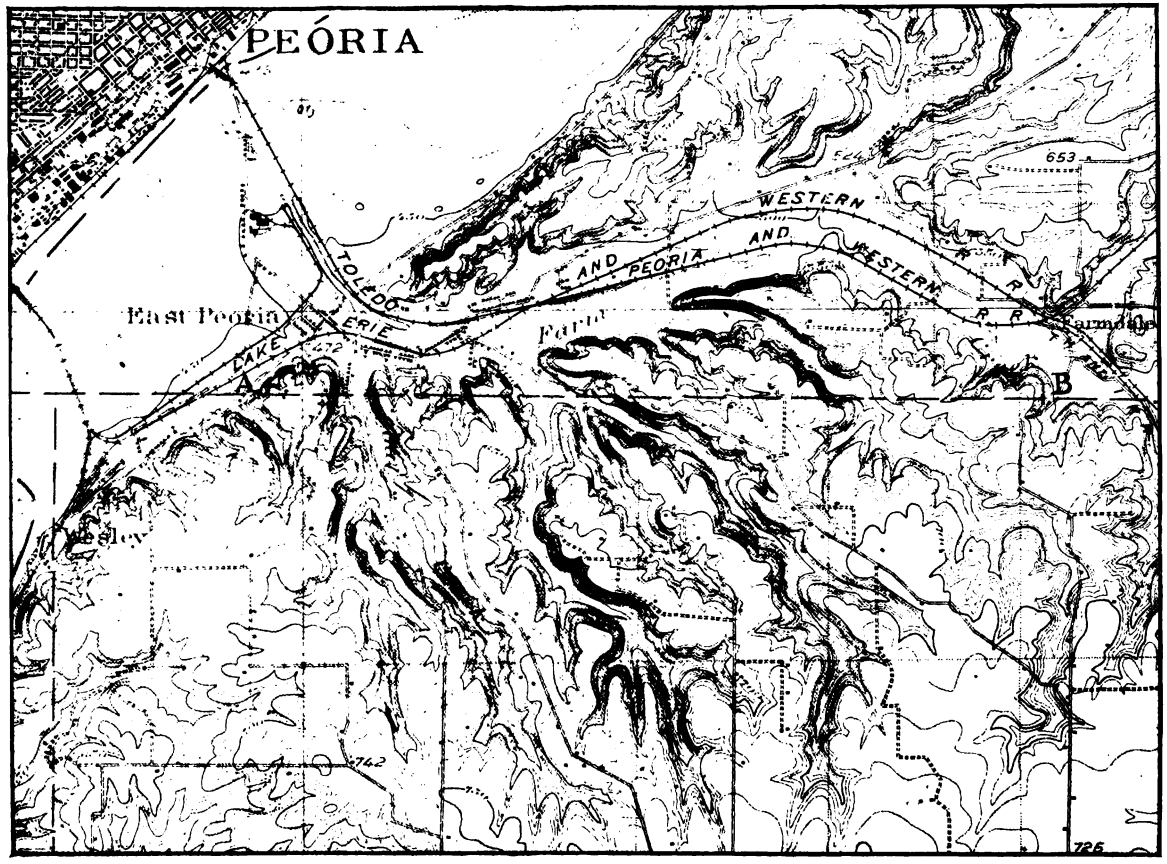
The terrace gravels are extensively used on wagon roads and for railroad ballast. The Atchison, Topeka and Santa Fé Railway Company ships gravel from its large pit at Chillicothe to all points along its road from the vicinity of Chicago to western Missouri. There are railroad pits also at or near Bureau, Hennepin, Henry, and Pekin. Since central Illinois has but limited supplies of good road material, these terrace gravels are likely to find a wide market in the future.

The terrace soils are generally sandy loams, though clay soils are not wanting, especially near the bluffs, where there has been more or less wash from the uplands since the terraces were formed.

Every important town of this part of the valley grew up upon a terrace, avoiding alike the bottoms, subject to floods, and the uplands, usually 150 or more feet above the waterway. The early relations of the villages to the river are reflected in the fact that the streets in the older quarters run parallel to the river front and at right angles to it, rather than with the points of the compass. The immediate location upon the terrace edge was in several cases determined by relatively large tributary streams on the opposite side of the valley, whose deposits crowded the river to the terrace side of its flood-plain. Pekin and Peoria appear to be striking illustrations of this control. Peoria has spread from its lower terraces to an upper one, and is now spreading back upon the upland.

The bluffs.—The bluffs which bound the Illinois valley vary considerably in height, reaching a maximum as already indicated, of over 250 feet. Their height is influenced by the varying altitude of the upland and the nature of the surface to which they descend. Where they separate the more elevated tracts of upland from the flood-plain, they are relatively high; where they intervene between the lower uplands and the terraces, they are relatively low.

The bluffs of the middle Illinois are commonly too steep for cultivation and remain wooded. The frontispiece and Plate 3 show their typical character. Their steepness indicates that a very short period, as geology measures time, has elapsed since the river, flowing at their base, undercut them and made them steep. In this moist climate, so much material would otherwise have washed from the upper slopes, lodging at the base,



Map of small valleys southeast of Peoria. (Portion of Peoria topographic map, U. S. Geological Survey.)

as to greatly reduce their steepness (Fig. 12). This is especially true since the bluffs of the Illinois, within the area with which this report is concerned, are almost exclusively of clay, sand, and gravel, rather than

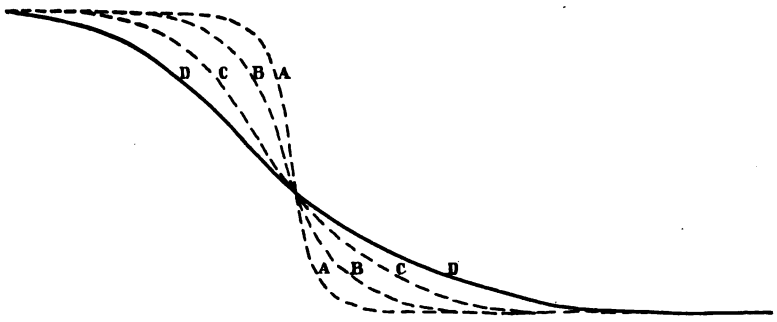


FIG. 12. Diagram to illustrate the reduction of a bluff by slope wash. Successive profiles are indicated by the letters.

firm rock. Locally the bluffs have much less than their customary steepness, and since their composition is essentially the same as where steeper, we conclude that such sections have been free from undercutting for a longer time. Plate 4, A shows low bluffs of gentle slope north of Bureau, and Plate 4, B shows the curve, concave upwards, which slope wash tends to produce.

Roads from the upland seek the valley bottom at infrequent intervals, often taking advantage of the floor of some of the larger ravines which trench the bluffs. The easier grades of the larger tributary valleys have located the railroads which traverse the region. The main line of the Chicago, Rock Island, and Pacific Railroad leaves the Illinois valley at the great bend along the valley of Big Bureau creek. Crow creek, opposite Chillicothe, affords the Atchison, Topeka, and Santa Fé Railroad an easy descent to the Illinois flood-plain. The valleys of Farm creek and Kickapoo creek, on opposite sides of the river at Peoria, are utilized by railroads seeking that city from the east and west.

The general valley features thus far described, are shown in Figure 13, a cross section of the Illinois valley at Peoria.

The upland.—The upland plain has a general elevation to the north of Peoria of 650 to 700 feet above sea level, and to the south of the city of 600 to 650 feet, within the area considered here.

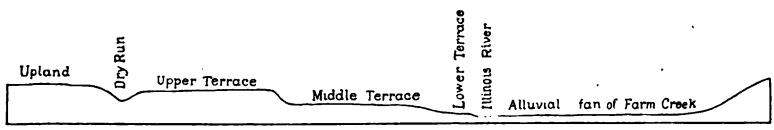


FIG. 13. Cross section of the Illinois valley at Peoria.
Vertical scale: 200 feet to 1 inch; horizontal, ½ mile to 1 inch.

The otherwise flattish topography of the uplands is broken, (1) by the numerous small valleys which border the Illinois, and (2) by certain low, broad clay ridges unrelated to valleys.

The small valleys.—Small tributary valleys and ravines border the Illinois valley on either side. They are frequently separated only by narrow tongues of upland, so that the surface is largely slope. This fact is brought out by Plate 2, which shows numerous small valleys east of Peoria by means of contours, and by Figure 14, which represents the character of the surface between the points "A" and "B" on the map. Throughout the area under consideration the valleys tributary to the Illinois valley (as in the case of those shown in Plate 2) are generally narrow and steep sided; they usually have high gradients and are often without permanent streams. While the great majority of these valleys are only a fraction of a mile in length, the dissected belt north of Peoria extends two to five miles from the Illinois valley, and it is considerably wider than that to the south of Peoria. Still farther back from the Illinois, the small valleys are less numerous and deep, and the upland surface therefore more regular.

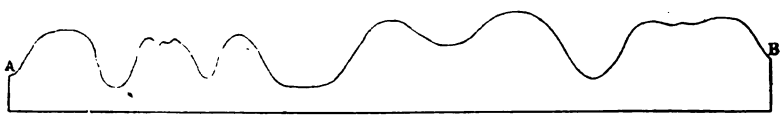


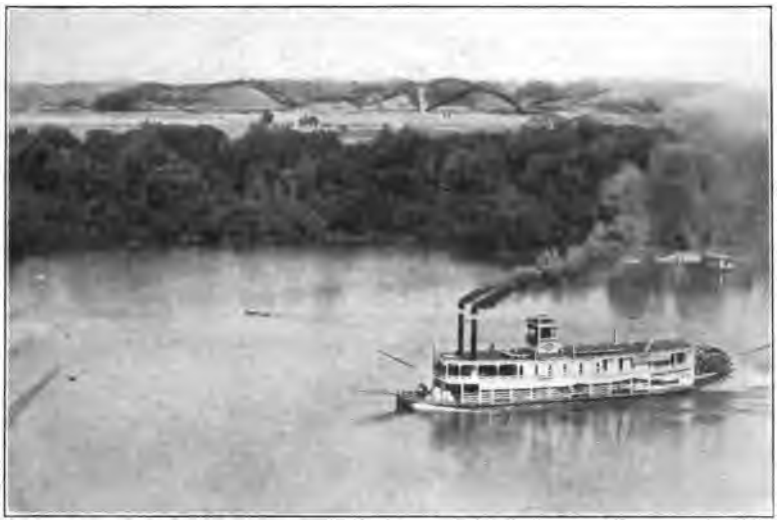
FIG. 14. Profile of surface between points "A" and "B", PLATE 2, showing irregular topography occasioned by small valleys.
Vertical scale: 200 feet to 1 inch; horizontal, ½ mile to 1 inch.

Those uplands from which the bluffs of the Illinois valley descend directly to the flood-plain are more rugged than the uplands which are adjacent to the terraces, for the valleys leading back from the flood-plain level are deeper than those which extend inland from the terraces.

Further characteristics of the small valleys may best be pointed out in connection with the discussion of their origin (p. 56). The great discrepancy in size between the Illinois valley and its tributary valleys should be noted, however, as again putting this valley system in contrast with normal valley systems.

The clay ridges.—The general distribution of these ridges, under the name of moraines, is shown in Figure 20. They extend, with varying characteristics, far beyond the area under discussion, as members of a complex series of ridges and hilly belts, which rudely encircles the head of Lake Michigan. In the area described here they commonly exceed two miles in width, and are locally a conspicuous feature of the landscape when viewed from the plain to the west of them. Near Groveland the ridge exceeds 790 feet in elevation, rising 140 to 150 feet above the plain which borders it two miles to the westward. The ridge extending northward from North Peoria is also well developed, its proximity to the Illinois valley accounting for the shortness of the ravines tributary thereto on the west, in comparison to those on the opposite side of the valley.

In the area under consideration, the surface of these ridges is usually rather regular, though always lacking the even crest popularly associated with the term. Locally, as near Groveland, their surface is diversified



A. View of Illinois valley north of Peoria, showing terrace and bluffs on east side. (Photo by Dewein.)

B. The flat in the middle foreground is part of an extensive terrace between Peoria and Mossville. The lower slopes of the valley side appear in the immediate foreground. (Photo by Dewein.)

by mounds and hillocks, sometimes associated with shallow, undrained depressions. Beneath a surface coating of brown silt, they consist of moderately stony clay.

The clay ridges stand in no definite relation to drainage lines and are therefore not remnants of once continuous uplands, whose surroundings have been worn lower by streams. Nor could the shallow basins which locally interrupt their surface have been formed by running water, since all stream valleys possess outlets. The special conditions under which these and other important features of the area developed, are considered in Chapter III.

Summary.—The more important general features of the region are the following: (1) A great valley of very irregular width, lying 150 to 250 feet below the upland plain, from which steep bluffs descend. (2) An aggrading river of extremely gentle fall, which flows sluggishly around the deposits of its tributaries, by which it is locally expanded to the dimensions of a lake. (3) An extensive flood-plain whose marshes and lakes withhold large areas from agriculture. The surface of the flood-plain rises very slightly along the river to form imperfect levees, and has been built above its normal level in places by the deposits of tributary streams and by rain wash from the valley sides. (4) A remarkable series of alluvial fans, by which the tributaries assist in filling the Illinois valley. (5) A system of extensive sand and gravel terraces. The surfaces of the terraces, originally nearly flat, are now diversified locally by sand hills and by small valleys. They have located the towns and cities of the region. (6) A flattish upland plain, deeply dissected by small valleys in the vicinity of the Illinois, and traversed by morainic ridges.

The history of the development of these features is traced in subsequent pages.

CHAPTER II.

THE BED ROCKS OF THE REGION.

Distribution of outcrops.—Bed rocks in definite layers are exposed (*outcrop*) along certain stream bottoms and valley sides within the area under discussion. They may be studied to advantage along the course of Kickapoo creek and several of its tributaries, at points along Lamarsh creek, opposite Pekin, and in the valleys of Gimlet and Thenius creeks, near Sparland, all on the west side of the Illinois river, and in the vicinity of Wesley on the east side. There are small exposures also in the ravines about two miles north of Chillicothe, along Rowe's Hollow, southwest of Henry, and near Marquette. Bed rock is not known to outcrop on the western side of the Illinois valley between Henry and Marquette, nor on the eastern side between East Peoria and a point some miles beyond Hennepin.

The above outcrops are the edges of essentially horizontal rock layers, some of which extend back beneath the uplands considerable distances. Very similar formations underlie the entire region with which this report is concerned, and extend far beyond it throughout much of the State. They belong to a great system of rocks known as the Pennsylvanian (Carboniferous) system, formed during the Pennsylvanian period.

Influence on topography.—Where exposed in valley sides, the bed rocks sometimes occasion nearly vertical slopes (Plate 5), though they form no striking scenic features, and in general exert little influence upon the topography. Borings show them to be commonly covered by two to three hundred, and sometimes by four to five hundred feet of clay, sand, and gravel.

Economic importance.—The principal outcropping rocks are shale, sandstone, limestone, and coal. All are of more or less economic value. Shale is quarried at several places south of East Peoria, for the making of tile and brick. Sandstone and limestone have been quarried locally for building purposes, and the latter for the manufacture of lime. Coal is the greatest mineral resource of Illinois. The output more than doubled in the decade 1895-1905, and in the year 1908 had a value of nearly $50,000,000. Four counties bordering on the middle Illinois river (Bureau, Peoria, Marshall, and Tazewell) furnished about one-twelfth of the total. The increase in production during the next decade

A. A section of the Illinois valley bluffs north of Bureau. The bluffs are here lower and less prominent than is common.

B. Lower valley side north of Bureau. The slope between "A" and "B" shows the depositional profile formed by rain wash.

(Illustration)

or two is generally expected to be even greater than that of the past decade, and the industry appears to have an especially bright future along the Illinois river, destined to be one of the great commercial highways of the world, when it becomes a link in the projected line of deep water navigation between Lake Michigan and the Gulf of Mexico (p. 121).

Such economic considerations make the coal bearing rocks of the middle Illinois valley, together with the conditions of their formation, of special interest.

Characteristics and origin of the sandstone.—Sandstone forms precipitous bluffs fifteen to thirty feet high at many points along the lower course of Kickapoo creek. Examination shows that the sandstone consists chiefly of medium sized sand grains bound together by a cement of calcium carbonate or iron oxide. The latter cement determines the brown color of much of the rock. Some of the more poorly cemented sandstone may be readily pulverized, when it resembles in all respects the finer sand accumulating along the flood-plain of the neighboring creek. The sandstone is in massive, nearly horizontal layers, some of them five feet or more in thickness. Thinner divisions (*laminae*) slanting in different directions, and meeting each other at various angles are conspicuous within certain layers. Rocks affected by such oblique *laminae* are said to be *cross-bedded.*

The foregoing characteristics of the sandstone throw some light on the geography of the environs of Peoria at the time the sand from which it was formed was deposited. The fact that the rock is in layers signifies that the sand was accumulated in water, to which it was brought largely by streams from the land of the time. The further fact that only sands were deposited here for some considerable time implies that the bottom waters were in sufficient agitation to prevent any muds that were washed down from the land coming permanently to rest. This means that the water was shallow, for waters are commonly stirred by waves, currents, the undertow, etc., only to comparatively slight depths. That the water was shallow is further proven by the cross-bedding of the sandstone. This structure is developed only along stream bottoms and off ocean and lake shores, where the depth is sufficiently slight for the bottom water to be in frequent agitation. The cement by which the loose sand was bound into firm sandstone was deposited from solution in percolating waters. Certain inferences may also be made concerning the land whence the materials of the sandstone came. It must have possessed at least moderate relief, for the streams of very low, flat lands are too sluggish to transport sand in quantity. Its rocks must have been of a kind whose decay would yield sand. It need not have been, and probably was not, close at hand; sediment may be rolled and dragged long distances along a shallow bottom before reaching a final resting place.

The sandstone formation just considered is not known to have extended throughout the area here considered. Varying depths of water or unequally strong waves and currents may have caused the accumulation at the same time of different materials in other nearby localities.

The shale and its formation.—Shale is the most common rock in the region. It consists of mud particles pressed and cemented into a compact mass. Fresh surfaces are generally blue or green in color, though locally an abundance of carbonaceous material renders the shale nearly or quite black. Upon long exposure to the weather it becomes yellow in consequence of the oxidation of its iron. The shale is commonly in thin layers, many of them but a small fraction of an inch in thickness. Thin bands and roundish masses of ironstone are locally included within the shale.

The several shale formations exposed in the area were probably formed under substantially the same conditions. As in the case of the sandstone, the fact that the shale is in layers indicates that the muds from which it was derived were deposited in water. Shale further requires water sufficiently quiet to permit fine silt to remain upon the bottom.

The limestone.—Limestone is much less abundantly exposed within the area than sandstone or shale. Occasional outcrops range in thickness from a few inches to some five feet, and in appearance from a dark gray, fine-grained rock to a very light colored, crystalline one. The beginning student will be helped in the identification of limestone by the fact that when it is treated with hydrochloric acid, a bubbling or effervescence is produced. Certain of these limestones contain many recognizable relics (*fossils*) of marine animals, and are doubtless made up chiefly of organic remains. These fossils prove that when the limey material now compacted into firm rock was deposited, the sea covered the area where the limestone occurs. Furthermore, since the limestone contains little sandy or clayey material, it is evident either that the areas of accumulation were some distance from shore, beyond the reach of land-derived sediment, or that the neighboring land was so low that its sluggish streams were unable to wash material in any amount to the sea. Certain limestones that do not appear to contain fossils occur within the region, and these may have been chemically precipitated from the waters of local basins or ocean embayments.

The coal.—Coal is the product of the partial decay and alteration of vegetation. Under the microscope it may in some cases be seen to be a mass of altered vegetable matter.[1] It frequently contains abundant remains of plants. Vegetable matter in various stages of change connects the coal by all gradations with the vegetation of present marshes. The coal plants grew where the coal now is. Had they grown elsewhere and been washed by streams to their present position, they would have been mixed with much mud, sand, etc. Great quantities of vegetable matter, essentially unmixed with sediment, are now forming only in bogs and swamps. It is therefore believed that each extensive coal seam along the middle Illinois tells of a vast marsh in which the dead leaves, branches, and trunks of thousands of generations of trees together with their undergrowths, formed thick layers of vegetal matter. The marshes may have developed in inland basins, in lagoons along the sea shore, such as now occur off the coast of New Jersey, the Carolinas, and Georgia, or on river flood-plains. Indeed, the imperfect peat now

[1] This does not mean that a piece of coal under the microscope reveals its vegetal origin, but that coal properly treated, and cut into sufficiently thin sections will, in the hands of the expert, reveal its cellular structure.

A. Pennsylvanian rocks exposed in Rowe's Hollow, southwest of Henry.

B. Exposure of Pennsylvanian rocks in Kickapoo valley, near Peoria.

forming in parts of the Illinois flood-plain, for example opposite Chillicothe, represents the first step in the formation of coal. It is not probable that any one marsh extended throughout the coal producing area of Illinois, though individual marshes may have covered the entire area of the middle Illinois valley.

Wood is composed chiefly of carbon, hydrogen, and oxygen. When it decays in the air, the carbon and hydrogen unite with the oxygen of the atmosphere and of the wood to form carbon dioxide and water. The other constituents are also disposed of by chemical combination, and the wood disappears. If the vegetation decays under water, however, it is protected from the atmosphere, and the elements of the wood unite with one another to a greater extent. The products of such decay withdraw the hydrogen and oxygen of the wood much faster than the carbon, which therefore makes up the bulk of the remaining mass. If this altered vegetation be buried under beds of sand or mud, further physical and chemical changes occur which help to produce coal. The conditions for the formation of coal are then abundant vegetation, protected by water from the oxygen of the atmosphere. These conditions are found only in such situations as those noted in the preceding paragraph.

Geographic changes recorded by exposed rocks.—The preceding paragraphs have indicated that each of the several kinds of rock exposed in the area originated under special and particular conditions. Since the strata alternate frequently, it is clear that many changes in physical geography occurred. The number and something of the nature of these changes may be inferred from a study of the following typical section, which is exposed at Schmidt's mine on the west side of the lower Kickapoo. Number 1 is the lowest (oldest) of the exposed beds:

	Feet.	Inches.
9. Shale, exposed about	4	.....
8. Coal	2	4
7. Fire clay	2 to 2	6
6. Sandy shale, with occasional sandstone layers	3 to 8	.....
5. Massive brown sandstone, about	30	.....
4. Shale, including thin bands of ironstone	5	10
3. Limestone	.....	5 to 12
2. Shale	2	6
1. Coal	4 to 4	6

The coal seam (No. 1) represents the accumulation of marsh vegetation for a very long period. This was terminated by an inflow of water, due to the subsidence of the swamp or to a rise of the surface of a neighboring water body. Fine muds (No. 2) were next laid down upon a quiet bottom, burying the organic matter. The accumulation of mud was succeeded by the formation of limestone (No. 3) when the land for some reason ceased to yield sediment, or its deposition was shifted to a new area. Renewed wash from the land or a shoaling of the water again allowed an influx of mud (No. 4). During this stage, iron that had been dissolved by ground waters from the soil and rocks of the land, was brought in by streams, and deposited to form thin bands of ironstone. Further shoaling of the waters by sedimentation or uplift, oc-

casioned the accumulation of sands (No. 5). A deepening of the water again caused the deposition of muds (Nos. 6 and 7). The occurrence of sandy layers within this shale formation points to occasional changes in the depth of the water or, more likely, in the strength of waves and currents. At length marsh conditions were restored (No. 8) by sedimentation building the bottom up to the water surface, or by an elevation of the bottom or a lowering of the surface of the water. This second swamp appears to have lasted about half as long as the first, judging by the relative thickness of the coal seams. Submergence led to the burial of its vegetation under the muds represented by No. 9.

The above section represents but a small portion of the Pennsylvanian system. Deep borings show that the rocks of this period have a thickness of some 1,200 feet in certain places in central Illinois. A general section of the Pennsylvanian rocks of the State prepared by Worthen represents the system as containing ninety-five distinct formations. Sixteen coal seams (not all workable) are indicated, separated by shales, sandstones, and limestones. No other system of rocks within the State records so remarkable a series of geographic changes.

Older formations.—As already indicated, no rocks older than the Pennsylvanian outcrop within the area covered by this report. Older beds have been penetrated by artesian wells, however, and locally they have importance as a source of public water supply. The porous, water-carrying formations in question rise slowly toward the north and come to the surface in south central Wisconsin. A part of the rain which falls there sinks into the ground and follows these slanting (*dipping*) porous beds to the south. Since each of them is covered by relatively impervious beds, the water they contain below the middle Illinois valley is under the immense pressure of a sloping column of water which fills the pores of the rocks, and extends northward to the area of outcrop. Accordingly, when the impervious cap is penetrated by a boring, the water is forced toward, and in some cases above the surface. Not all the artesian wells of the area reach the older (pre-carboniferous) formations. The public wells at Putnam and at Bureau, for example, obtain water from the Pennsylvanian rocks.

The older formations outcrop more or less extensively in neighboring areas, where they have been studied in some detail. The general characteristics which they there possess are believed to hold in the area here described. Deep borings are so few, however, that it cannot be affirmed with certainty that all the formations mentioned below extend throughout the area, nor that others do not exist in parts of it. Figure 15 shows in the order of their occurrence, the formations encountered by the deepest wells of the region. The general succession of events recorded by these formations may be very briefly indicated, commencing with the oldest formation.

Lower Magnesian limestone.—This formation, which is reached by the artesian wells at Princeton, is the oldest formation exposed within the State. It may be seen a few miles beyond the area under consideration, near Utica. Here an up-warping of the beds has exposed formations, which a short distance to the west are deeply buried.

The Lower Magnesian formation is in north central Illinois a complex series of beds, containing many layers of limestone and sandstone. The limestone beds are made up chiefly of the remains of marine animals, which dwelt in clear and quiet, but only moderately deep water. During the formation of these beds the areas of accumulation were therefore beyond the reach of abundant sediments from the land. The associated sandstone layers show that now and again sands were washed to the places under consideration. The alternation of limestone and sandstone layers may have been brought about by variation in (1) the depth of the water, (2) the strength of waves and currents, (3) the height of the adjacent land, or (4) the volume of the streams draining the land. An influx of sand would be invited by shoal waters, strong waves and currents, and high land drained by large streams. The Lower Magnesian limestone is widely distributed outside the area considered in this report, registering conditions similar to those described above over a large area in the northern Mississippi basin.

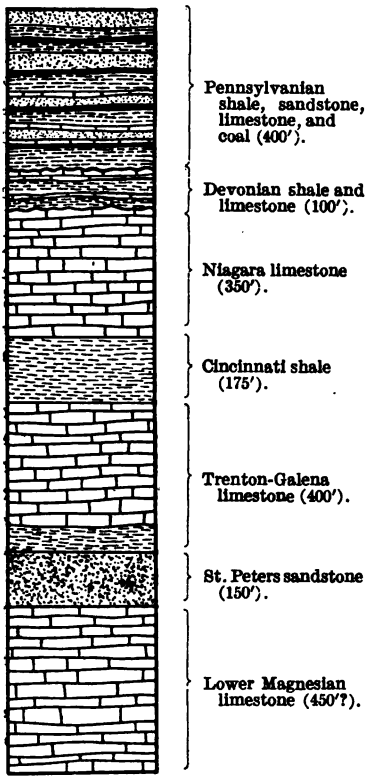

Pennsylvanian shale, sandstone, limestone, and coal (400′).
Devonian shale and limestone (100′).
Niagara limestone (350′).
Cincinnati shale (175′).
Trenton-Galena limestone (400′).
St. Peters sandstone (150′).
Lower Magnesian limestone (450′?).

FIG. 15. Section showing rock formations that are penetrated by the deepest wells of the northern part of the area.

St. Peters sandstone.—During the epoch following the deposition of the Lower Magnesian limestone, the region was covered with water sufficiently shallow to insure the uninterrupted deposition of sand. These conditions are recorded by the St. Peters sandstone, which has a thickness of over 150 feet at Princeton.

Like the subjacent formation, the St. Peters sandstone has a wide distribution beyond the area here considered. It is commonly very porous, and so an important reservoir for artesian waters.

Trenton-Galena limestone.—This limestone implies another change in the conditions of sedimentation, the probable nature of which will be readily inferred from preceding paragraphs. A slight deepening of the water or a lowering of the land appears to have excluded the waste from the land, and permitted the remains of lime-secreting organisms to gather upon the floor of the shallow sea until a deposit over 400

feet in thickness was formed. Fine sand and shales at the bottom of the formation suggest a gradual transition from the conditions of the preceding epoch.

Cincinnati (Hudson River) shales.—The next younger formation is composed primarily of shale, and subordinately of limestone. During the greater part of the epoch the region would therefore appear to have been in the outer part of the zone within which the waste of the land accumulates, and beyond the reach of coarse sediment. An occasional clarifying of the ocean water would have allowed the formation of the associated limestone. The formation has a thickness of 175 feet at Princeton.

Niagara limestone.—The Cincinnati formation is overlain in this region by some 325 to 350 feet of limestone comprising the Niagara formation. This limestone points to conditions of sedimentation with which we have become familiar; a sea deep enough so that waves and currents were ineffective at the bottom, upon which the remains of thousands of generations of sea animals gathered.

Devonian shales and limestones.—Artesian wells at Hennepin and Princeton show 100 feet of shales and limestones resting upon the Niagara formation. The Devonian system of rocks, to which they are thought to belong, is separated in northern Illinois from both the underlying and overlying beds by an erosion surface. Each of the erosion surfaces (*unconformities*) indicates (1) a period of submergence during which the beds below the unconformity were deposited, (2) emergence, due to elevation of the sea floor or lowering of the water surface, (3) a period during which the exposed beds suffered erosion, (4) submergence, and (5) the deposition of the younger beds upon the eroded surface of the older formation.

The beds which overlie the Devonian are the Pennsylvanian beds, whose formation during a long period of oscillation when the region stood at and near sea level, has already been described.

Time involved.—The remarkable series of events outlined above covered a period of vast length. While it will never be possible to determine its length accurately, it doubtless comprised many millions of years.

Uplift and erosion.—Following the deposition of the Pennsylvanian beds, the region under discussion was exposed as land and, so far as known, never again submerged beneath the sea. The new land surface probably had some such topography as a plain formed by the withdrawal of the waters off the east coast of the United States would have. That is, it probably possessed a moderate seaward slope, with inconspicuous minor unevennesses. Since cementation is usually a very slow process, the material of the new land may well have been feebly and imperfectly bound together.

The new land surface became at once the scene of activities which are now in progress in the region, and are therefore a matter of common observation. Then as now the rain penetrated the pores of the rocks and often removed their soluble materials. Surface rocks were split and broken through alternate expansion and contraction under the influence of heat and cold. Fragments of rock were pried off by the

freezing of water in the cracks and interstices. By these and other processes of *weathering,* constant additions were made to the initially loose surface material.

Furthermore, then as now, the finer surface material was frequently shifted from place to place. Winds probably blew dust and sand in quantity from bare surfaces and deposited it elsewhere. The effect was to roughen the surface, lowering it in some places, and building it up in others. Such rain as did not immediately sink into the ground, or evaporate, ran off the surface. If, as suggested, the general seaward slope of the land was modified by minor slopes, the run-off would be uneven, concentrating along the lowest lines of descent. Clay, sand, and at times perhaps coarser materials were dragged and pushed down-slope, in largest quantity along those lines where the volume of the run-off was greatest. The greater removal of material along such lines created depressions, which were steadily enlarged by the waters which subsequently flowed through them. These depressions were valleys. When their bottoms were worn below the level at which the rocks were full of water, water from either side flowed into and along the valleys, forming permanent streams. Much of the rock waste washed by the streams along their channel floors was carried beyond the area under discussion, to the sea.

The effect of cutting many valleys was to make the originally flattish surface rough. But streams cannot erode their channels much below the surface of the lake, sea, or other river into which they flow, and can reduce them to that level only at and near their mouths. As they cut their valleys toward this final level their gradients become less and less steep and their currents therefore more and more gentle. When they become sluggish, the streams may be readily turned aside by obstacles, and directed against the valley sides. Side cutting develops a valley flat at the expense of the inter-valley uplands. The latter are also reduced by other agents which aid the streams, and the entire surface may finally be worn down to a flattish plain, as near sea level as running water can bring it. Such a plain is a *base-level plain.* A plain in the stage of development preceding this final condition, is a *peneplain.* Its surface is usually characterized by isolated hills formed of resistant material or so situated as to have escaped erosion, which rise abruptly above their nearly level surroundings. The time necessary for the production of a base-level plain is a *cycle of erosion.*

If a base-level plain be elevated and the slope of its streams thereby increased, they begin at once to lower their channels, and unless prevented by other geological agents, will in time again reduce the area to base-level. The region considered in the report may have been base-leveled more than once before the advent of the ice sheets that deposited the clay, sand, and gravel which commonly cover deeply the bed rock. Such a possibility is especially likely since extensive base-leveling is known to have occurred in a large unglaciated area in northwestern Illinois and adjacent states.

If a sufficient number of wells reached the bed rock and their records were available, it would be possible to describe in detail the relief of the underlying rock, but unfortunately for this purpose, the great majority of the wells terminate in the glacial material, and only a general notion of the topography before the deposition of the glacial mantle may be obtained. The principal feature of the pre-glacial topography was the Rock-Illinois valley (Fig. 16), whose floor is shown by well borings at several places to be about 100 feet below the level of the present river.

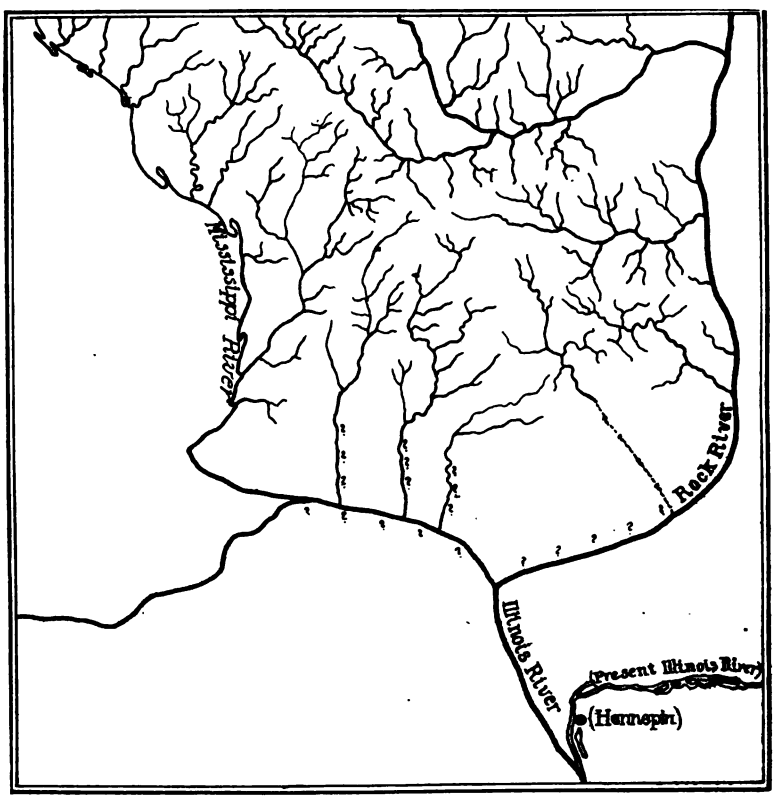


FIG. 16. Map showing portion of pre-glacial Rock—Illinois river system. (Leverett.)

It has been conjectured that the pre-glacial Rock-Illinois river was joined by the upper Mississippi at a point to the north of Hennepin (Fig. 16), though this is by no means proven. The pre-glacial uplands were apparently much dissected by tributary valleys, and rose in places nearly 450 feet above the Rock-Illinois channel. The region appears to have been a rugged hill and valley country, possibly closely resembling the unglaciated area of the northwestern corner of the State.

CHAPTER III.

THE GLACIAL PERIOD.

The mantle rock of the area is of foreign derivation.—As indicated on preceding pages, the Pennsylvanian rocks of the region of the middle Illinois are generally covered with clay, sand, and gravel to an average thickness of probably over 200 feet. These materials occur separately in many places, and are elsewhere confusedly mixed in all possible proportions. It has long been known that this mantle rock was not produced by the weathering of the underlying rocks, for it contains much material, for example bowlders of igneous rocks, to which the decay of the bed rocks could not give rise.[1] This fact is also shown by occasional exposures of the contact between the mantle rock and the underlying rock. Mantle rock formed in place normally grades more or less insensibly into the firm rock beneath (Fig. 17). This is a consequence of the gradual downward diminution of the work of the atmosphere, ground waters, plants, animals, and other agents of weathering. At the exposures in question, however, the surface material gives place

FIG. 17. Diagram showing the relation of mantle rock to the underlying rock from which it was derived. (Courtesy of U. S. Geol. Surv.)

abruptly to the unaltered rock below as suggested in Figure 18. The mantle rock of this region, therefore, was brought to its present position by one or more of the agents which transport materials upon the land. Together with similarly imported materials which have wide d tribu-

[1] The foreign derivation of the granite bowlders was discussed as follows in 1836: "Bowlders, or detached masses of stone, are occasionally seen on the prairies, lying loosely on the ground, not only entirely separate from the limestone pan beneath, but differing from it in kind. They are obviously not meteoric; and it seems that they have been wrenched from their native beds, and brought to the places where they are now seen, by some great convulsion of nature. They are granite, and there is no spot at which that description of rock exists, and from which they could have been brought, nearer than the Allegheny, or the Rocky mountains, or the northern shores of the lakes. Yet they are numerously scattered throughout Illinois and Missouri." (Hall: Statistics of the West (1836), p. 95.)

tion over the northern part of the United States, it is known as *drift*. This term was applied under the impression that it had been drifted by waters to its present situation from outside sources.

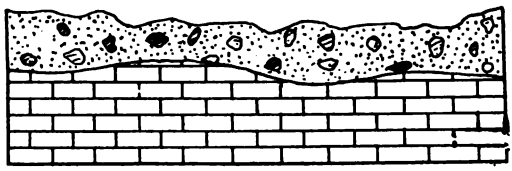


FIG. 18. Diagram to show the relation of drift to the underlying rock.

The transporting agent.—Plate 6, B shows a typical exposure of unstratified drift (*till*) near Henry. Similar exposures may be seen throughout the region. As in the illustration, the till usually consists of material of many kinds and sizes, and is not in layers. Some of the angular stones and bowlders have flat faces, often highly polished, and covered with minute scratches (Plate 7). The drift is sometimes (often in other areas) quite irregularly disposed, so as to occasion hilly belts and undrained depressions. The stones and bowlders are frequently of kinds which do not occur as bed rock nearer than Canada. The transporting agent, therefore, gathered its load from an area sufficiently large to yield many different kinds of rock, and was capable of carrying large bowlders as well as fine clay, sometimes for great distances. It was capable, furthermore, of giving a part of the stones it carried the characteristics noted above, but was incapable of arranging its irregular deposits in layers.

It is evident that the transporting agent in question was neither the wind nor running water. The size of the material would, among other things, at once exclude the former, while various considerations as effectually dispose of the latter. The largest bowlders of the till, weighing tons, are far beyond the transporting power of ordinary streams. Streams tend to round the stones rolled along their channels, and are unable to develop flat faces. Stream-laid beds are in layers. The surfaces of water deposited beds are without notable irregularities, such as occasionally characterize the till.

Plate 6, A shows irregular deposits recently made by the Alaskan glacier in the background, that possess all the characteristics of those shown in Plate 6, B. So far as observed all the deposits being made by existing glaciers, show these same characteristics. Since existing glaciers are developing exactly the features belonging to the drift of the area under discussion, and since no other agent is known, capable of so doing, we may confidently conclude that the region of the middle Illinois was formerly covered by glacier ice. This glacier was as extensive as the till is widespread, and is therefore known to have covered at its maximum development, the area shown in Figure 19.

The glaciation of the region complex.—Further considerations make it apparent that this area was invaded by glaciers more than once, and

A. An Alaskan glacier and a portion of its deposits. Angular material similar to that in the lower right hand corner extends back to the point "A", where it rises up out of the ice. (Photo by Martin.)

B. Typical exposure of till near Henry. (Photo by Crane.)

at widely separated intervals. A recent cut of the Peoria and Bloomington Electric Railroad, near the former city, shows the following beds, number 1 being the lowermost and therefore the oldest:

	Thickness.
4. Stony till—Bottom 14 ft. blue and highly calcareous; upper 25-30 ft. brown; upper 4-5 ft. non-calcareous, and reddish-yellow in color	39-45 ft.
3. Buff to yellow, non-calcareous silt (Loess)—Pebbleless; contains many small snail shells; bottom 6 inches drab-gray color	5-5½ ft.
2. Gray to jet black clay—Black portion contains much humus, together with many twigs and small branches	30-34 in.
1. Till	Few inches exposed at base of section.

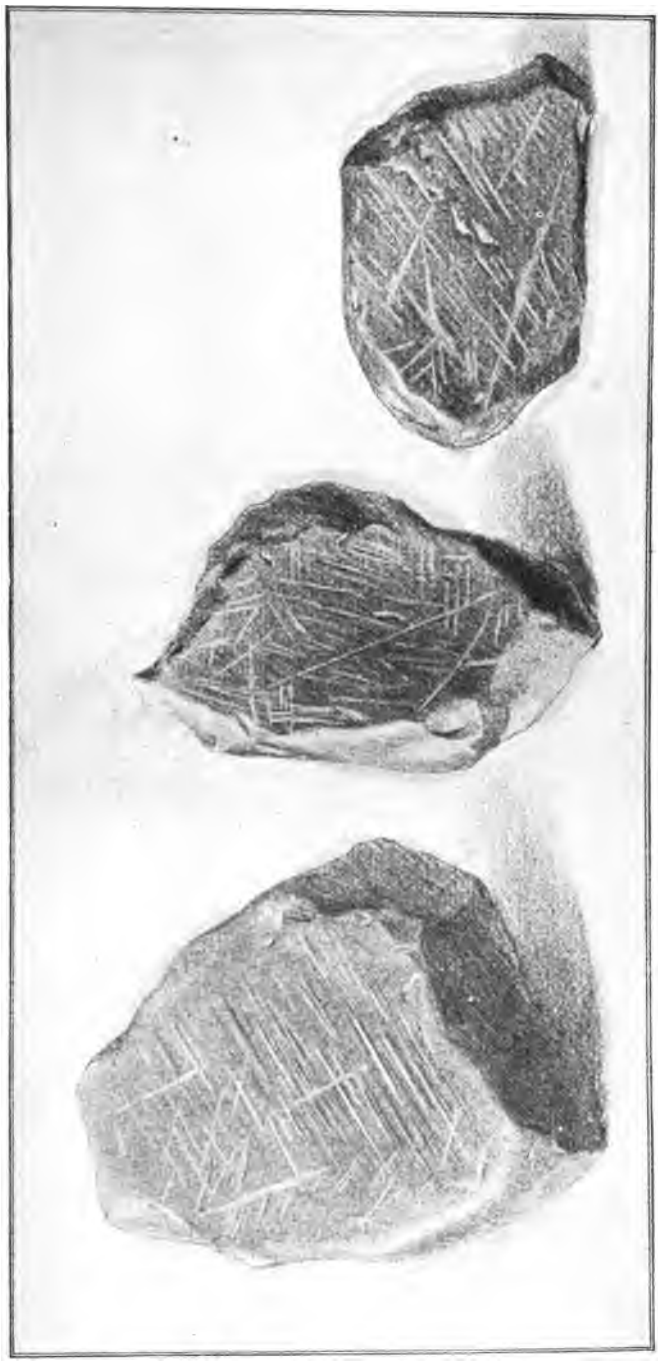
This section records the following sequence of events. (1) The presence of the ice sheet by which the till (No. 1) was deposited. (2) An amelioration of climate which caused the ice to melt back so far and

FIG. 19. Map showing maximum extent of ice sheets of Glacial period in North America. (U. S. Geol. Surv.)

remain away so long that plant life, slowly invading the abandoned area, grew upon the deposits left by the ice, decaying roots, leaves, twigs, etc., mingling with the clay to form a layer of soil (No. 2). (3) The deposition thereon by wind or water of fine silt (No. 3). (4) Since the silt (loess) of this horizon is elsewhere calcareous, save in its uppermost portion, it seems reasonable to suppose that the silt of this section was also originally calcareous. If so, its deposition was followed by a period of weathering, during which the loess was leached of its calcareous constituents. That such leaching occurred before the deposition of the overlying material is evident from the fact that the bottom of the till which rests upon the loess is highly calcareous. (5) A readvance of the ice, which overrode the earlier beds and deposited the till indicated by No. 4.

South of Peoria, the valleys tributary to the Illinois are, on the average, larger and more numerous than those north of the city, and the upland is, in consequence, more dissected. Since these valleys are developed in material of essentially the same resistance, this indicates that the drift area to the south has been longer exposed to the work of the agents by which valleys are developed, than has that to the north, or in other words that the drift sheets in which these different sets of valleys have formed, are of unequal age. Figure 2 shows the difference between the Spoon river and the lower Sangamon river systems, developed in the area of the older drift, and the drainage systems of the younger drift. The former have numerous tributaries which branch widely; the latter display little branching. The greater age of the southern drift sheet is also indicated by the fact that ground waters have removed its soluble constituents and oxidation has given it a brownish-yellow color to a greater depth than in the case of the northern sheet. From such considerations as the foregoing, it has been determined that there were five distinct invasions of the United States by glaciers during the Glacial period. These epochs of ice invasion were separated by periods when the ice retreated an unknown distance to the northward, and the abandoned areas experienced the more familiar geological work of the atmosphere and of running water. There were also minor advances and retreats, evidence of which in the area under discussion, appears below. The general sequence of events during the Glacial period is traced in the following pages in so far as it affected the region of the middle Illinois river.

The formation of the glaciers.—At the beginning of the Glacial period the climate of northeastern Canada became such that in certain areas more snow fell each winter than melted and evaporated during the ensuing summer. The resulting accumulation of snow constituted a *snow field.* It increased in thickness with the contributions of successive winters. It became larger as the conditions of excess of snowfall over snow waste were extended. This extension the snowfield itself promoted by lowering the temperature of the surrounding atmosphere, thus inviting an increasing proportion of the precipitation in the form of snow, and at the same time retarding melting and evaporation.



Glaciated stones, showing form and striæ. (Doseff.)

Meanwhile the snow field became an *ice field* by the same processes which each winter transform many snow banks into ice banks. (1) The bottom snow was compressed by the weight of that above, the result being something like that when loose snow is packed into an ice-like ball in the hands. (2) Water from rains and from surface melting during the warmer periods sank into the snow beneath and freezing, formed ice which helped to cement the mass together. (3) The snow crystals underwent changes in form which aided in the development of compactness.

From the circumstances of its development, the growing ice-field, with its cover of lately fallen snow, had greatest thickness in the center, diminishing more or less regularly to the margins, where wastage balanced snowfall. The pressure upon the bottom ice was accordingly greatest near the center, decreasing to zero at the edges. In consequence the ice slowly spread in all directions under its own weight. The ice-field had become a *glacier*.

In the general way indicated, one glacier or ice sheet developed east of Hudson Bay, while a second formed to the west (Fig. 19). Slowly spreading by marginal addition of snow as well as by movement, these glaciers joined south of Hudson Bay, and in the course of the Glacial period covered the area already referred to in Figure 19.

The Illinoian stage of glaciation.—So far as known, the area described in the report was invaded only by ice from the Labrador region, moving in a general south-southwesterly direction. The direction in which the ice moved is shown by the direction in which the material of the drift was transported, and by the trend of the margins of the till sheets which occur within the region. The first invasion of this region that has been recognized was the third invasion of the United States. It is known as the Illinoian stage of glaciation and its deposits as the Illinoian drift.

As suggested on page 24, a general notion of the character of the topography at the coming of the ice may be had from the records of wells scattered throughout the area. They show that the present Illinois river below Hennepin follows the course of a great pre-glacial valley (Fig. 16), whose floor was some 100 feet below the present stream bed. This valley was bordered by uplands that appear to have been well dissected by small valleys, and that in places were nearly 450 feet above the Rock-Illinois river. The surface of the ground was presumably mantled by loose material derived from the underlying rocks.

Many erosion slopes faced the invading ice and acted as obstacles to its advance. The relatively thin edge of the ice sheet, thus opposed, probably crept very slowly over the uneven ground. Its first effect was doubtless to remove the loose surface material. Wherever the water in the soil upon which the ice encroached was frozen, it cemented the soil particles into a firm mass. Wherever this ice-cemented soil became frozen to the glacier ice above, it became, in effect, a part of the ice sheet, and was likely to be carried on by its further movement. Some loose material may at times have been pushed forward by the advancing ice edge, though the great mass of it was probably gathered by the under

surface of the ice. Such material may have been dropped and picked up again many times before reaching a final resting place. Elevations in the path of the ice might occasion lodgment. Moving vigorously over a surface yielding abundant material, the ice might gather a load which it was presently, under changed conditions, unable to move. At its edge the moving ice was continually melting, the excess of movement over melting being the measure of its advance. In consequence of this marginal wastage, rock material picked up by the ice at some distance back from its edge would, if not dropped, find itself in time at the margin, whose melting would occasion its deposition. Overridden by the advancing ice, it might once more be taken up, to be again dropped after a longer or shorter journey. The removal of the loose surface material was undoubtedly followed by more or less erosion of the bed rock. This is largely a matter of inference, as the bed rock is for the most part buried deeply by drift. Since it is much softer than rock, pure ice accomplishes little or no wear upon its bed, rather is it worn by the harder rock. As indicated above, however, the bottom ice was charged with rock fragments and thus armed, glaciers become efficient agents of erosion. Their rock tools are pressed with great force upon the surfaces over and against which they move, and each kind accomplishes its appropriate work. Clay particles tend to smooth and polish, sand grains and hard pebbles to scratch (*striate*) and bowlders to groove and gouge the bed rock. Meanwhile, the tools are themselves worn. The weaker ones are presently ground into fine bits. The stronger are typically marked, their sides being worn flat and like the bed rock, often polished by clay and striated by sand (Plate 7). Such glaciated stones may be seen in almost every exposure of till throughout the region.

The effect of glacier erosion was probably to plane away minor irregularities of the surface, reducing and smoothing the slopes. Where hill tops were worn, the tendency was to reduce the pre-glacial relief. Where the ice moved along the axes of valleys it tended to widen and deepen them, and so to increase the relief. Where it crossed valleys, the ice was likely to erode chiefly the sides out over which it moved.

The Illinoian ice sheet covered the entire area under description and pushed well beyond it. On the west it crossed the Mississippi river and advanced some distance into Iowa, while it fell short of the Ohio river at the south by only a few miles (Fig. 20). This was the limit of its advance, because here wastage balanced movement. It is evident that all material moved by the ice to the limit of its advance would be deposited, and that the longer the ice edge remained stationary the more considerable the deposit would be. The resulting thickened edge of a drift sheet is called a *terminal moraine.*

After a time, wastage exceeded forward movement and the edge of the Illinoian ice accordingly withdrew from the area covered by this report, and from much or all of the territory it had covered within the limits of the United States. As it melted back, all the material that had been on top of the ice, in the ice, and beneath the ice was left on the deserted surface, together with the material that had been deposited

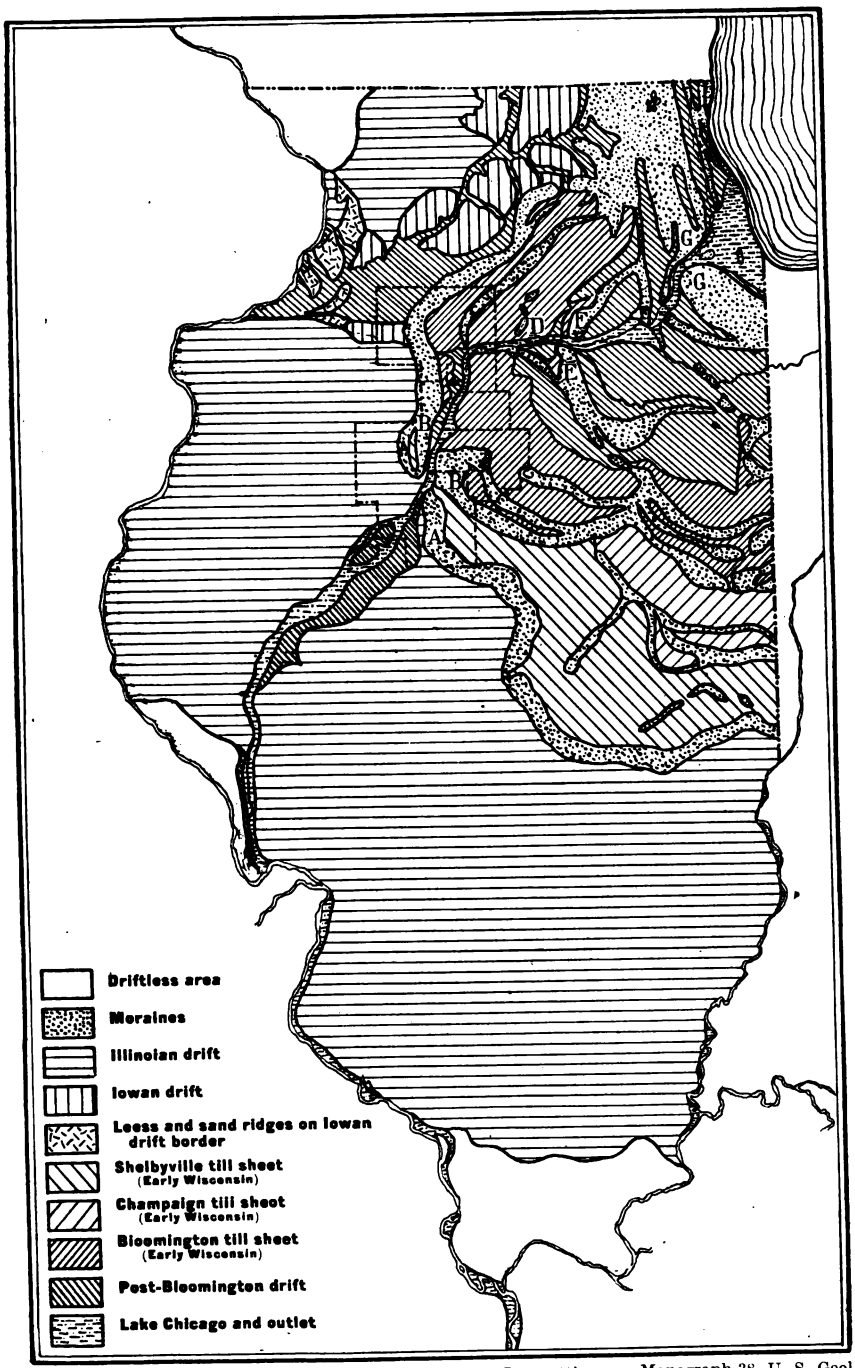


FIG. 20. Generalized glacial map of Illinois. (Data from Leverett's map, Monograph 38, U. S. Geol. Surv.)

while the edge of the ice was advancing and while it remained stationary. The material deposited beneath a glacier back from the terminal moraine, constitutes the *ground moraine.*

Stratified drift.—While deposits that were made directly by the ice are without stratification, a considerable proportion of the drift was deposited by waters associated with the glaciers, and is therefore stratified.

Deposits of this class were probably made before the advent of the ice. Waters formed by melting ice in some cases found valleys leading away from the ice front. Loaded with debris from the ice, such streams probably aggraded the valleys they followed, the deposits assuming the structure common to stream-laid beds (p. 8). Such valley fillings, built by streams beyond the ice edge, are known as *valley trains* and will receive more detailed consideration later. When the advancing ice occupied the lower courses of valleys, but not the upper, it acted as a temporary dam and formed a pond or lake, on whose floor stratified deposits were made. The stratified drift deposited beyond the advancing ice front was later overridden by the ice sheet, and wholly or in part modified, removed, or buried by till.

During the time that the Illinoian ice sheet covered the area under discussion, stratified deposits were probably making in places beneath the ice. Water from the surface melting of summer doubtless found its way in part through cracks and crevasses to the bottom. Some melting, furthermore, occurred at the bottom because of friction with the rock beneath. In these and other ways very considerable quantities of water accumulated under the ice, and were at certain times and places concentrated into definite sub-glacial streams which deposited sand and gravel along their channels. These deposits may have been laid down upon bed rock, upon earlier stratified drift, or upon till, and may have been subsequently covered by later deposits, either stratified or unstratified.

During the withdrawal of the ice from the region, glacial waters tended to make deposits similar to those formed during its advance. These deposits, in so far as they were made by waters flowing outward from the ice edge, were not subject to modification or burial by the Illinoian ice.

From the foregoing it will be seen (1) that glacial waters tended to form stratified drift in certain places under the ice and at and beyond its edges, during its advance over the area, while it covered the region, and during its retreat from it; and (2) that such stratified drift may be under, within, or on top of unstratified drift deposited directly by the ice. Further complexity in the deposits of an ice sheet is brought about by the fact that the advance and retreat of its edge are commonly interrupted by temporary halts and minor movements in the opposite direction. It is therefore not surprising that locally, as along the valley of Kickapoo creek and the Illinois river near Peoria, much stratified sand and gravel occurs in the Illinoian drift. In keeping with the above principles, also, limited exposures of stratified gravel appear in the

midst of the till at numerous points, apparently marking the sites of glacial streams. This gravel has been frequently cemented by deposition of material from solution in ground water, so that it forms a rock sufficiently strong to have been used for the foundations of buildings.

The Illinoian till is commonly yellow or yellow-brown in the upper 10-15 feet, because of the oxidation of its iron; it grades downward into unweathered gray till.

Effect of the Illinoian glaciation upon topography.—The general effect of the Illinoian glaciation of the region was to reduce its relief. With the exception of the Illinois valley, the pre-glacial erosion channels seem to have been largely or wholly filled with drift and to have practically ceased to exist as surface features. An essentially plane surface replaced the rugged pre-glacial topography. This change is illustrated in Figure 21.

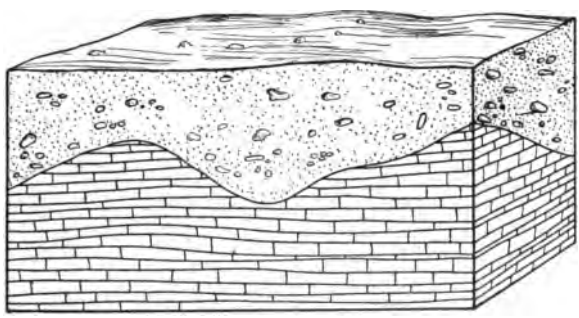


FIG. 21. Diagram to illustrate how rough pre-glacial topography may be replaced by a smooth surface through the deposition of drift.

Another important consequence of the glaciation of the region, which has been referred to the Illinoian stage, was the diversion of the upper portion of the Rock-Illinois river. The bluffs of the pre-glacial valley have been traced by Leverett from the point where the present Rock river turns sharply to the southwest in southern Winnebago county, nearly to the southern boundary of Ogle county, where they disappear beneath a heavy deposit of drift. Well records seem to show that the old valley continues past Princeton to the bend of the Illinois at Hennepin. The displacement of the river is referred to this, rather than to a later stage of glaciation because the work the stream has accomplished in its new course seems out of proportion to that known to have been done by other streams since later stages. The ice appears to have filled the valley, displacing the stream to the westward. When the ice withdrew, the valley was choked with drift and the river had found a lower line of discharge to the southwest, in part along the line of pre-glacial tributary valleys. The abandoned valley was further buried by later drift sheets.

The Sangamon interglacial epoch.—At the withdrawal of the Illinoian ice sheet the area with which the report is concerned became at once the scene of new activities. Fine material blown about by the winds found lodgment in new situations or was carried outside the area. The chemically active oxygen of the atmosphere entered into combination with certain constituents of the drift, giving its surface a color resembling that of rusted iron. The rain-water that sank into the ground dissolved the soluble material near the surface. The streams took up the task of reducing the surface which the ice had built up. The conditions of their work were unlike those which affected the preglacial streams. In general, the slopes were less steep and the streams, therefore, more sluggish. This disadvantage was in some measure counteracted by the less resistant material upon which they worked. The Illinois was probably seriously retarded in the work of clearing out its lower valley by the loss of the waters formerly contributed by the Rock river. Plants and animals presently re-established themselves in the area, and influenced the operation of other agents. The remains of plant life mingled with the surface material to form soil.

The record of these interglacial activities is preserved in the leached and reddened upper surface of the Illinoian till, in shallow valleys, and in old soil layers. These features were clearly developed before the deposition of the overlying beds, and may be seen in certain places where the latter have been removed by erosion. The soil of this time is exposed at the point on the Peoria and Bloomington Electric Railway referred to on page 27, and the weathered surface of the till is shown at many points south of Peoria below a capping of younger silt.

Judging from the coniferous trees represented by bits of wood preserved in the Sangamon soil, it has been thought that the climate of the region during at least that part of the interglacial epoch when these trees grew, was much colder than at present. The duration of the interglacial epoch is not definitely known, but the weathering accomplished seems to indicate thousands of years. The Sangamon interval was brought to a close by another epoch of glaciation, known as the Iowan.

The Iowan loess.—The extent of the ice sheet at the Iowan stage of glaciation is indicated by the extent of the Iowan till.[1] The ice is accordingly known to have fallen short of reaching the southern line of western Bureau county, as indicated in Figure 20. Some distance west of Princeton the southern edge of the Iowan till passes beneath a heavy deposit of younger drift, so that its southern limit within the area of the report is unknown. Quite possibly it did not extend south of Bureau county. The near approach of the ice was of moment to the entire area with which the bulletin is concerned, however, because of an important deposit of loess to which it gave rise. The loess in question is widely distributed beyond the area here described. It is believed to

[1] Question has recently been raised concerning the correctness of the current interpretation of the Iowan drift.

be genetically related to the Iowan ice because it thickens toward the edge of the Iowan drift sheet, upon which it extends but a short distance.

Loess is silt intermediate in coarseness between fine sand and clay, into both of which it grades. Predominantly buff yellow in color, it is in some cases dark brown and in others blue gray. Its mineral composition is essentially that of the drift from which it appears to have been derived. Typical loess is pebbleless, without distinct stratification, and frequently contains concretions and large numbers of fossils. The concretions are aggregations of lime carbonate of irregular shape (Plate 8, B), formed by deposition from solution in ground water of material leached from the surrounding loess. The fossils are the shells of minute mollusks (gastropods) which were buried in the gathering loess.

The loess appears to have covered originally the entire surface of the Illinoian drift in this region. It has been extensively removed by erosion in the vicinity of the Illinois river, but often remains intact upon the uplands, where it has an average thickness of 12-15 feet. The loess is composed of somewhat larger particles and is more porous near the Illinois valley, and grades inland into a clayey earth. Numerous exposures show a vertical variation in the character of the loess. At the top there are 3-5 feet of weathered brown clayey loess, mixed with more or less humus. When dry, this top loess breaks readily into minute angular blocks. It grades downward into the typical buff loess, which is occasionally replaced near the bottom in the deeper cuts by a blue-gray silt.

The origin of the loess is a mooted question. It has been held to be (1) a wind deposit, (2) a water deposit, and (3) in part eolian and in part aqueous. The theory that it is exclusively a wind deposit has met difficulty in the fact that it sometimes contains material apparently too coarse to be handled by the wind, and possesses lines of water sorting. The theory that it is entirely water-laid is opposed by its presence on divides far above the reach of depository waters, together with its absence from lower tracts which should have been flooded before the higher ones. There has accordingly come to be rather general agreement that both wind and water were concerned in its deposition, but there remains wide disagreement as to the relative importance of the two agents. It has been suggested that silt that resulted from glacial grinding may have been carried out from the Iowan ice by sluggish aggrading streams that spread it broadly over wide flats at flood times, from which it was in part removed by the wind and redeposited upon the neighboring uplands. The present tendency is to assign an eolian origin to the larger part of the loess.

The Peorian interglacial epoch.—The loess which caps the Illinoian drift extends beneath the Wisconsin drift (footnote, p. 36), described below, where the loess outcrops in certain valley slopes. At the Peoria and Bloomington Railroad section noted above, the loess has a thickness of six feet and is non-calcareous. The blue till which overlies it is highly calcareous. It is therefore evident, as already noted, that the loess, un-

doubtedly originally calcareous in common with the Iowan loess generally, was leached of its limey constituents prior to the deposition of the overlying till. The period of weathering recorded by this and similar sections, which followed the deposition of the Iowan loess and preceded the advent of the Wisconsin ice has been called the Peorian interglacial epoch.

Weathering and erosion are much less pronounced than at the Sangamon stage and so obviously record a shorter interval.

The Shelbyville ice sheet.[1]—The erosion and weathering just noted were brought to a close by another incursion of the ice. The drift sheet which records this advance is named from the city of Shelbyville, situated at the southwestern extremity.

Not all the area described in this report was covered by this ice sheet, the limit of its advance being marked by the Shelbyville terminal moraine, Fig. 20, at "A." Since the ice continually moved material forward to its thinned margin, and there deposited it, the submarginal drift accumulated faster than that farther back beneath the ice; and because the position of the ice edge remained essentially constant for a long period, the marginal thickening of the drift became considerable. This thickened belt of drift is the terminal moraine. It is most conspicuous when viewed from the Illinoian drift plain beyond, above which it rises rather abruptly, sometimes as much as 150 feet. The descent from it to the inner (eastern and northern) plain is much less, and is accomplished more gradually.

The topography of the moraine within the area described in the report is hardly typical of terminal moraines in general. Its surface is rather smooth and regular, whereas terminal moraines are more often characterized by irregular, hummocky topography. Not infrequently they contain numerous mounds, hillocks, and short ridges, associated with depressions without outlet, which often contain ponds or lakes, the whole huddled together in confusion. The elevations of such moraines range in diameter from a few feet to a half mile and more, and occasionally reach a height of 100 to 200 feet, while the depressions vary in depth from inches to scores of feet, and in area may cover many acres. Perhaps the nearest approach to this type of topography within the area here considered is in the vicinity of Groveland, where shallow basins two to six feet in depth may be seen in connection with low mounds. Plate 8, A shows morainic topography a few miles from Bureau, while Fig. 22 illustrates the stronger type which characterizes certain other moraines of northeastern Illinois and Wisconsin. It has been suggested that the usual irregular topography of a terminal moraine may have developed in the following manner: (1) More material was likely to be moved to the vicinity of the edge of the ice in some places than in others. In such situations the moraine tended to become higher and wider than elsewhere. (2) As in the case of present glaciers, the edge of the ice was doubtless subject to minor oscillations; melting back by summer and advancing in winter; withdrawing during a period

[1] The drift sheets that are younger than the Iowan are commonly grouped as the early Wisconsin drift sheets, and the late Wisconsin drift sheets. The Shelbyville drift and the Bloomington drift (p. 38) are of early Wisconsin age.

A. Morainic topography in northern part of area, with gentle swells and shallow basins.

B. Exposure of loess containing concretions. The concretions are surrounded with black lines. (Photo by Crane.)

of warmer years, with winter halts or short advances, to recover part or all of the lost ground during a period of cooler years. At each stage of such oscillations the irregular edge of the ice may well have failed to be parallel to many or all of its earlier positions in much or all of its course, in which case the submarginal accumulation of drift then made was not parallel with earlier deposits of similar origin. Rather, the lines of debris marking the various positions of the edge of the ice crossed or met and receded from one another many times, enclosing depressions of diverse shapes and sizes. (3) The drift may have buried great detached blocks of ice, which, on melting, permitted it to settle unequally, forming depressions.

FIG. 22. Sketch of strongly developed terminal moraine topography.

The failure of the Shelbyville moraine and of the Bloomington moraine (discussed below) to display pronounced irregularities of surface within the area, may be due to the edge of the ice having been unusually constant in position at those stages and more or less uniformly charged with debris.

The Shelbyville ice appears to have accomplished little erosion in this region, in numerous places scarcely disturbing the surface material over which it pushed. This was probably due to the fact that the flattish surface developed by the earlier glaciation offered little opposition to its advance, and to the fact also that the heavily loaded border of the ice sheet which covered the area was in a depositing, rather than an eroding condition.

The Shelbyville drift probably does not contain as much sand and gravel as the Illinoian. The great mass of the material is a moderately stony blue clay. This grades into a yellow till in the weathered zone.

The silty loam which covers the outer slope of the moraine points to sluggish drainage from the ice front, strikingly in contrast with that at the next stage (p. 39 *et seq*). The absence of vigorous outwash from the Shelbyville ice edge, even along such favorable lines as those afforded

by the Illinois and Kickapoo valleys, is singular. Since there was obviously abundant material to be washed forward from the ice, the apparent absence of outwash in such valleys can be explained only by assuming that the issuing streams were of little volume, and that their channels were of low slope. It is difficult to see how these streams could contain little water, unless fed by a small amount of melting ice. If this view be entertained, it must also be assumed that the marginal ice, whose wastage balanced ice advance, was in the main disposed of in some other way than by melting; in other words, by evaporation. This would in turn seem to demand an arid or semi-arid climate in central Illinois at the time.

The Bloomington ice sheet.—The Bloomington moraine (Fig. 20, at "B") is named from the city of that name, centrally located upon it. The edge of the ice remained stationary along this line for a period sufficiently long to permit the submarginal accumulation of drift to become notably thicker than that farther back. The ice edge did not merely halt in this position in its retreat from the Shelbyville moraine. Having withdrawn an unknown distance, it again advanced to this line. This is indicated by the fact that shallow valleys, cut in the Shelbyville drift, received the outwash from the Bloomington ice front. Furthermore, the older moraine disappears beneath the Bloomington moraine in the northeastern part of Peoria county near Lawn Ridge. North of this point, and west of our area, the younger moraine has been found to be in contact with pre-Wisconsin drift (footnote, p. 36). For the interval between the Shelbyville retreat and the Bloomington advance no name has been given. The inner Bloomington moraine, which extends northward from the vicinity of the great bend of the Illinois (Fig. 20, at "C") may be a recessional moraine, merely registering a stand of the retreating ice.

The description of the Shelbyville moraine and drift (p. 36) is in the main applicable, within the area here considered, to the Bloomington moraine. Between Peoria and Lawn Ridge (Peoria and Dunlap topographic sheets) the moraine is prominent, reaching in places an elevation of 820 to 830 feet above sea level, nearly 100 feet above the narrow Shelbyville drift plain to the west. The crest of the Bloomington moraine here acts as the divide between the upper waters of Kickapoo creek and the small valleys leading eastward to the Illinois river. As noted on page 14, the proximity of the moraine to the Illinois valley determined the shortness of the valleys heading on its eastern slope. These valleys gradually lengthen northward as the distance increases between the moraine and the main valley. In the vicinity of the eastern bluff of the Illinois valley the moraine is weakly developed, merging gradually into the inner plain.

The surface of this moraine nowhere displays pronounced irregularities, apart from those developed on its slopes by stream erosion. North of Peoria only occasional depressions two to five feet in depth were noted, associated with inconspicuous swells. East of the river there is even less departure from planeness. The hummocky topography reported to

characterize the inner Bloomington moraine to the north of the area of the report, becomes subdued as the Illinois river is approached, in the vicinity of which the moraine appears to fade out entirely. Low mounds and shallow basins on the uplands east of Hennepin are in line with this moraine, which reappears on Leverett's map (Fig. 20) in eastern Woodford county.

The surface of the till, where exposed, is commonly weathered to a depth of 5 to 8 and sometimes 10 to 15 feet. Beneath this yellow-brown zone, the body of the drift, like the Shelbyville drift, consists of rather soft blue stony clay, with occasional beds of sand and gravel. The softness of the Wisconsin drift of the area is in contrast with the hardness of the underlying Illinoian drift. This may be due to the partial cementation of the older drift, or to its having been deposited beneath thicker ice, whose greater weight more effectually compressed it.

Valley trains.—Valley trains were briefly referred to on page 32, in connection with the Illinoian glaciation of the region. Their development is worthy of more detailed consideration at this point, since remnants of valley trains of Wisconsin age, now terraces, are among the most conspicuous features of the middle Illinois valley (Fig. 3).

When streams flow away from glaciers in valleys of moderate slope, they are commonly overloaded with debris derived from the ice, which they therefore deposit along their channels, building river plains of sand and gravel. Such aggradational plains are valley trains (Fig. 23).

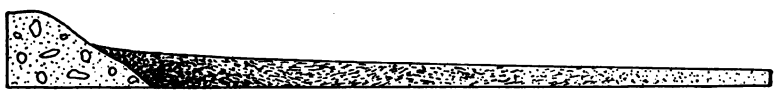


FIG. 23. Diagram of a valley train.

The stream deposits more and coarser material near the ice, and less and finer sediment farther from it. The down-stream slope of the valley train is therefore steepest near the ice, and increasingly gentle away from it (Fig. 23). Small streams greatly overloaded with very coarse material build valley trains of high average gradient. Larger streams less burdened with smaller material build trains of gentler average slope. Minor irregularities in the slope of the valley train and in the distribution of its material may result from rapid wash from recently exposed drift covered tributary slopes beyond the ice front. This may indeed be a not unimportant factor in the overloading of the river, and the building of its train. The longer the ice edge from which the aggrading stream issues remains stationary, the greater the valley filling. Heavy deposits accordingly point to protracted stands of the edge of the ice.

The Illinois river, as it issued from the ice sheet which at the Bloomington stage of glaciation lay across its valley, probably presented an appearance not unlike the river shown in Figure 24, which is rapidly aggrading its channel. The waters of this stream flow in numerous channels which frequently meet and divide. Deposition along the floor

of a given channel reduces its capacity. Presently the channel is unable to hold all of its water, and a portion breaks over the side and follows a new line. The new channel becoming choked, gives off branches, which in turn divide. The overflowing waters, following the lowest accessible lines of descent, may reunite only to separate once more a little farther down valley. By this process the river is broken up into many minor streams which are continually shifting. Such rivers are *braided rivers*. The material deposited along different channels at any given time is likely to be of unequal coarseness, while that deposited at a given place at different times may vary within equal limits. This helps to explain the structure of ancient valley trains, and of many other stream

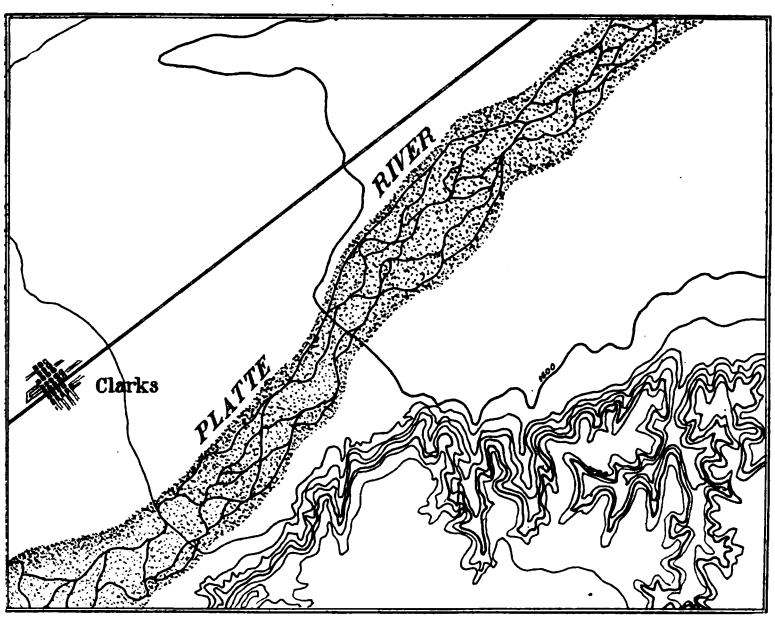
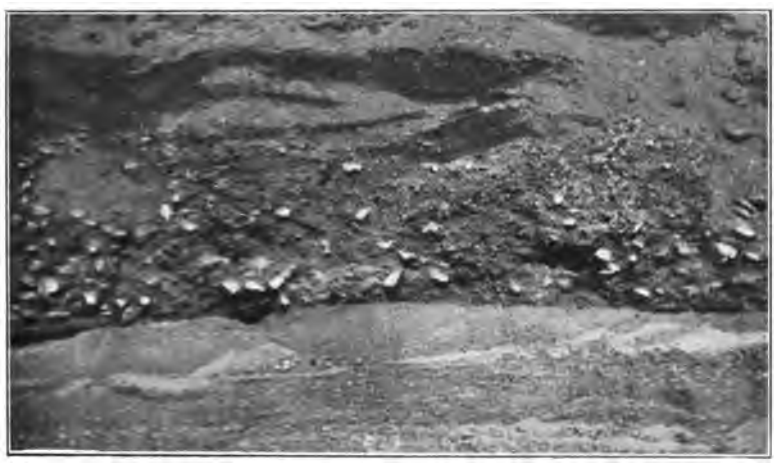


FIG. 24. Map of a braided river. (Drawn from the Stromsburg topographic sheet.)

deposits as well. The structure of valley trains is illustrated by Plate 9, and may be studied at the various terrace sand and gravel pits scattered throughout the region. The lower Mackinaw river, south of Pekin, is a braided stream.

Development of terraces from valley trains.—Following the withdrawal of a glacier from its valley, a stream may be relieved of the excess of load which led to the building of its valley train. Wash from the tributary slopes is likely to presently decrease also, as vegetation secures a hold upon them, and fastens the surface material. If the stream finds itself greatly underloaded, it lowers its channel rapidly, developing a new valley in the aggraded floor of the old one, whose remnants constitute elevated terraces (Fig. 25). Such a degrading



Exposure of material in a valley train, showing structure of beds.

river becomes less swift as the slope of its channel becomes more gentle; finally its relatively sluggish current is turned against its banks, and side cutting increases as vertical wear diminishes. The terrace is narrowed where undercut by the river, and may be cut into disconnected sections (Fig. 26). Finally the valley train may be wholly removed.

If as the ice withdraws, the load of the river is gradually and slowly reduced, so that it remains nearly loaded for a period, it may shift from side to side of its valley, while it slowly degrades its channel, and thus develop a series of terraces. This is illustrated in Figure 27, where a stream is supposed to have filled its valley with stratified drift to the level A-B, and to occupy a position near the left edge of its flood-plain.

FIG. 25. Diagram showing terraces developed by a river sinking its channel into a valley train.

FIG. 26. Diagram showing how a river may destroy terraces by side cutting.

If the stream now shifts toward the opposite side of the valley, meanwhile degrading, it will presently occupy the position C. Should movement to the right stop there, because of contact with a projection of the old valley wall, or for some other reason, and the river return to the left side of the valley, a remnant of the old flood-plain, C-D-B, would remain as a terrace. This terrace might extend a considerable distance along the valley, or only a short distance, and its width might vary notably. In similar manner should the river fail to reach the left side of its valley on the return swing, a terrace would result, as at E—A. Many terraces at successively lower levels might result from a continuation of this process. It is evident that such terraces upon opposite sides

of the valley will not correspond in elevation, and that they may be destroyed wholly or in part by the widening of the flood-plain at a lower level. The top of the terrace C-D-B is an aggradational flat; the surfaces of the younger terraces at lower levels are degradational flats.

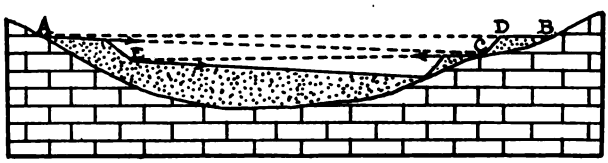


FIG. 27. Diagram illustrating development of terraces by a slowly degrading river which shifts from side to side of its valley.

A somewhat different sequence of events was involved in the production of the terraces shown in Figure 28. The valley was filled with stratified drift to the level A—B. Subsequently the river cut a new valley in the drift filling, leaving terraces at A and B. Later the stream was forced to again aggrade, possibly by a return of the ice to its upper course, and filled the new valley to the level C—D. Still later the stream

FIG. 28. Diagram showing two sets of terraces developed from aggradational flats.

again degraded its channel, leaving terraces at C and D. The case here suggested would have been complicated had the river at either or both periods of erosion, degraded slowly while swinging from side to side of its valley, instead of entrenching actively.

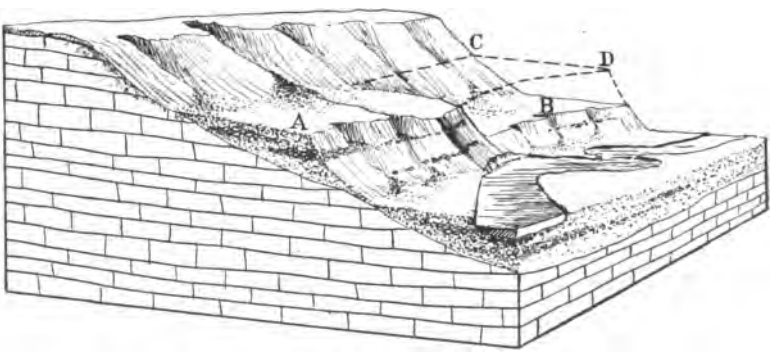


FIG. 29. Diagram to illustrate relations of terraces of unequal height to one another.

The terrace A in Figure 29 is clearly older than the lower terrace B. The ice edge may have lain across the valley at the upper end of A long enough for the issuing waters to fill the valley to the level of A. If the ice then withdrew from that position, and halted farther up valley, the extra-glacial waters may have filled the valley to the level B. Or, aggrading its valley to a level higher than B at the second stand of the ice, the river may subsequently have removed the deposits to that level. If at the first stand of the ice, its edge lay across the valley above the present head of the terrace A, that terrace of course extended to the ice front. It rose up valley and must therefore have been well above B, at C—D. The surface B may have been formed, in this case, by degradation from the surface C—D, or, wearing its channel below B, the stream may subsequently have aggraded to that level.

The terraces along the Illinois, described below, afford illustrations of the principles suggested above.

Outwash from the ice edge at Peoria.—The greatest filling of the Illinois valley, judging by existing terraces, occurred at Peoria. A part of the upper section of the city stands upon a gravel terrace which is 170 to 175 feet above the river. The constitution and structure of this terrace is shown in nearly a score of gravel pits, and in numerous other exposures. It appears to have been formed at the Bloomington stage of glaciation. This is suggested by the fact that it coincides in elevation with the lower end of a valley train of similar composition along Farm creek on the east side of the river, which is known to head in the Bloomington moraine. A remnant of the Farm creek valley train may be conveniently seen in a pit in East Peoria, on Pekin avenue, where 20-25 feet of cross-bedded sand and gravel are exposed. Both terraces nearly fill shallow valleys that were cut in the Shelbyville till before the Bloomington advance of the ice.

The stratified drift of the upper terrace at Peoria is covered, at least in places, by a few feet of till. This points to a slight temporary advance of the ice front beyond its main position in the northern part of the city, just prior to its final withdrawal. The ice appears to have pushed out over a part of the terrace before this, judging from an exposure above the Chicago and Northwestern Railroad tracks south of the mouth of Dry Run, where a bed of till containing large bowlders occurs within the stratified drift. This illustrates a statement on pages 36-37, to the effect that an essentially stationary ice edge often shifts within narrow limits.

The surface of the terrace slopes gently toward the west. Apparently the aggrading stream was withdrawn from a position along that edge of its flood-plain before its channel was filled. This abandoned channel appears to have subsequently guided the run-off from the uplands to the west, determining the peculiar course of Dry Run in the northern part of the city. Flowing south for about four miles, it turns sharply to the west on the inner edge of the terrace and joins the Kickapoo, instead of continuing south to the Illinois. Such abandoned terrace channels appear frequently to control the courses of minor streams. Crow creek,

west of Henry, and the creeks on the inner edge of the Hennepin terraces, are examples. Myers Lake, on the inner edge of a terrace east of Pekin, that is nearly 100 feet above the present river, represents an abandoned section of the terracing stream. A similar lake (Goose Lake) formerly existed along the lower inner edge of the middle terrace at Peoria; elderly people report skating upon it in their youth.

The upper Peoria terrace is 259 feet above the rock floor of the preglacial Illinois river, and as noted above, about 175 feet above the present river. This records valley filling to a depth of 259 feet before the retreat of the Bloomington ice, and excavation since to a depth of 175 feet.

The highest terrace at Pekin has a general elevation of 520-530 feet above the sea. Gravel beds occur at about 520 feet, the material at higher levels being sand. This has been blown by the wind into sand hills which reach an elevation in places of 550 or more feet. The 520-530 foot terrace appears not to represent the full height of valley filling here at the time the upper terrace at Peoria was formed. (1) It would involve a decline of surface of seventy to eighty feet in ten miles, and of only twenty to thirty feet in the next fifty miles, where at the mouth of the Sangamon river Wisconsin gravels are reported to have an elevation of 500 feet. This seems a rather improbable gradational slope, though not an impossible one. (2) A valley train of Mackinaw river which heads in the Bloomington moraine has an elevation of 550 feet where that valley joins the Illinois valley some miles below Pekin. The reduction of the upper Pekin terrace from its supposed higher level occurred subsequent to the withdrawal of the ice edge from Peoria, and it may have carried the valley floor below the present upper terrace level. In that event it was probably built up to the present level when the ice edge stood near Chillicothe, as noted below. In the process of lowering its valley floor from the level of highest filling, the river probably undercut and steepened the bluffs east of Pekin; slope wash has since reduced them slightly, spreading clayey material over the inner edge of the sandy terrace plain.

Filling of tributary valleys.—The effect of deposition by the Illinois river upon some of its tributaries occupying valleys in the Illinoian drift, is worthy of note. Along Lamarsh creek, opposite Pekin, there are terrace remnants at 510-520 feet, which are being undercut in places by the stream. Here it may be seen that the terrace material is laminated clay. The very thin horizontal layers (laminæ) are variable in color, oftenest chocolate or dark purple. Occasionally stones of some little size are embedded in the clay. The structure and composition of the material indicate that it was deposited in the quiet waters of a lake or pond, rather than in running water. The material with which the Illinois river rapidly filled its valley near Pekin acted as a dam across the mouth of Lamarsh creek, whose lower waters became essentially stationary. The stagnant waters of the ponded stream were able to transport fine silt only. In the winter season, bowlders were sometimes frozen into the ice that formed in the shallow waters near the

head of the stream, or fell upon the ice from the valley sides. Later, such bowlders were floated down stream by ice blocks, and dropped on the silty bottom.

Since the laminated clays noted above occur at the level of the present stream, it is evident that a valley developed after the withdrawal of the Illinoian ice from the locality, and before the advance of the Bloomington ice to Peoria, whose bottom was at least as low as that of the present valley. And because the highest existing terrace levels are eighty to ninety feet below the adjacent uplands, the erosion accomplished between the Illinoian and Bloomington stages of the Glacial period appears to have been considerably greater than that accomplished between the retreat of the Bloomington ice and the present. It should be noted in this connection, however, that since the 520-530 foot level east of Pekin seems not to represent the extent of valley filling there, the 510-520 foot level along Lamarsh creek probably does not indicate the extent of filling in the tributary valley.

Outwash from the ice edge near Chillicothe.—The constitution of the valley drift near Chillicothe appears clearly to indicate a stand of the ice edge at that point. In a railroad terrace pit about a mile north of the town some 25 feet of rudely bedded sands and gravels are exposed. These beds are exceptional because of the many large bowlders which they contain; hundreds of bowlders two to five feet in diameter are scattered over the floor of the pit, while a few are eight feet or more in diameter. So numerous are these bowlders that the Atchison, Topeka, and Santa Fé Railroad Company abandoned the pit, opening a new one something over a mile to the southwest, where fewer of them have been encountered. No material approaching in coarseness that at Chillicothe is found up the valley until the great bend is reached. This seems to indicate conclusively the presence of the ice front when the Chillicothe beds in question were deposited. Many of the bowlders appear too large to be handled by the river, and it has been suggested that they were dropped directly from the overhanging ice. Occasional large bowlders are found down the valley nearly to Mossville on the west side of the river, and beyond Spring Bay on the east side. These may have been floated out from the front of the glacier by blocks of ice, and subsequently lowered to their present position near the river bank by the removal of the fine material with which they were associated.

The valley was filled in the vicinity of Chillicothe at least to the present level of the highest terrace, 550 feet. Elevations on the terrace above this height are thought to be due entirely to wind work. A well defined 550-foot flat, probably to be correlated with this, occurs on the opposite side of the river, southeast of Spring Bay.

Possible outwash from the ice edge near Henry.—It is possible that the edge of the ice was stationary for a time across the valley a short distance north of Henry. Terrace drift in the form of cross-bedded sand and gravel occurs at Putnam at an elevation of about 550 feet; the highest terrace gravels noted north of this point reach but 535 feet

east of De Pue and 525 feet northeast of Hennepin. If, after the development of a 550-foot aggradational plain in the vicinity of Henry, the ice withdrew and halted farther up the valley only long enough for its issuing waters to build a plain to the level of 525-535 feet, the present relations would be brought about. As indicated in the discussion of Figure 29, however, the observed facts may be explained otherwise. The upper Henry terrace may be a portion of a plain developed beyond the edge of the ice, when the latter stood above De Pue, the upper portion of the plain having been eroded subsequently to the level of 535 feet. No record of a stationary ice front at Henry is preserved by morainic ridges on the adjacent uplands.

The upper terrace at Lacon is probably to be correlated with the upper terrace near Henry. Both show by their topography that they are considerably older than the next lower terrace; their surfaces, originally essentially flat, are now quite undulatory, while the 490-500 foot terrace is practically unmodified.

Outwash from the ice edge east of De Pue.—Evidence of outwash from a stationary ice edge near the eastern margin of the Hennepin quadrangle is much clearer than at Henry. (1) No well defined terraces appear on the topographic maps to the eastward which reach within less than 60 or 70 feet of the 530-540 foot terrace near De Pue. (2) Large bowlders comparable to those at Chillicothe, occur in the valley drift. It is true that the majority that are exposed are at low levels near the river, but they may have been lowered to that position by removal of underlying finer material, as suggested for those south of Chillicothe. (3) The terminal moraine shown on Figure 20, at "C," registers a halt of the margin of the ice at this point.

As suggested under the preceding heading, the 530-540 foot terrace may not represent the full extent of valley filling at this point.

Outwash from points beyond area of report.—It is doubtful whether the middle Illinois valley was aggraded by outwash from the ice when the several moraines which cross the upper Illinois (Fig. 20) were deposited.

No terrace above 460 to 470 feet is shown on the topographic map below the moraine at Utica. The 460-470 foot terrace appears to extend some distance above the moraine and therefore to have been formed at a later stage. Terrace remnants at 460 to 470 feet occur within the area of the bulletin from Hennepin to Pekin. Their surfaces seem to be degradational flats, as noted below.

Leverett has found evidence of a lake-like expanse of waters having existed between the moraine at Utica (Fig. 20, at "D") and the ice front at Marseilles, and later between the Marseilles moraine (Fig. 20, at "E") and the ice edge beneath which the Minooka Ridge (Fig. 20, at "F") and the Valparaiso moraine (Fig. 20, at "G") accumulated. The debris from the ice gathered in these basins, whose overflow down the Illinois valley was doubtless nearly free from detritus. Erosion, rather than deposition, would therefore appear to have been in progress at these stages in the middle and lower Illinois valley. This erosion is referred to below.

Development of the lower terraces.—The surfaces of the lower terraces shown upon the topographic maps of the area are probably degradational flats that were developed by the river in accordance with the principles suggested in connection with Figure 27. The development of these levels in the southern part of the area may have begun while the river was depositing nearer the ice which still covered the northern part. Their development throughout the area proceeded steadily during the presence of the ice in the upper Illinois valley, as noted under the preceding heading. The lowest terrace remnants, 460-470 feet, occur as already indicated at intervals from Pekin to Hennepin and beyond. These are thought (p. 48) to represent the level of the flood-plain at the time the Illinois valley became the outlet of Lake Chicago.

The Chicago Outlet.—The withdrawal of the ice to the northeast of the site of Chicago uncovered the lower end of the basin now occupied by Lake Michigan. Between the receding ice front and relatively high ground to the south and west, in part that of the Valparaiso moraine, glacial waters gathered to form Lake Chicago (Fig. 20). The area of the lake increased with the continued recession of the ice sheet, and at one time greatly exceeded that of Lake Michigan. Lake Chicago discharged along the line of the Illinois valley to the Mississippi and the Gulf[1], the overflow constituting a river of great volume, estimated to have had a depth of twenty-five to thirty feet.

This powerful stream carried on more vigorously the work begun by its smaller predecessor. It degraded its channel rapidly where it found weak material, and more slowly where resisted by strong rocks. Above Utica, where the river was flowing in a glacial valley, it encountered bed rocks of varying strength. On these it developed a relatively high, but irregular profile, steeper where the rocks were resistant and gentler where they were weaker. In the area considered in the report, only the drift filling of the preglacial valley was found, and the river lowered its channel, Prof. Cooley estimates, some thirty feet below the present valley bottom, developing a very gentle gradient.

Given time enough, the Outlet river would have worn the rocks of its upper channel to a uniform and gentle grade, continuing that of the lower valley. When this task was only well begun, the retreating ice sheet uncovered a lower outlet for the lakes, and the Chicago outlet was abandoned. Had the Chicago Outlet river completed its work, the Great Lakes, save Ontario, would now have the Illinois river, rather than the St. Lawrence, as an outlet. In that case the middle Illinois valley would lack the characteristic features that have developed because of the inability of the present stream to carry on the work of its predecessor.

The position of the middle Illinois valley when it first received the discharge of Lake Chicago is uncertain. It has been suggested that

[1] A water-gap in the rock rim of Lake Michigan basin at Chicago, 20 miles to the northeast of the mouth of the Illinois river, has been suggested as the outlet of Lake Chicago. Such a course would have been shorter than that of the Illinois valley, but it would have been much more difficult to excavate. The Illinois valley was the line of least resistance, and it was naturally followed by the outlet river.

bottom of the valley at Hennepin was at an elevation of about 490 to 500 feet. This view is opposed by the existence of terraces below the level indicated. These terraces were not formed by the present Illinois river which, as indicated below (p. 53), has built up the floor of the Outlet river only to the level of the present flood-plain, and the Outlet river, on the other hand, does not appear to have been a stream which degraded leisurely as it swung from side to side of its valley, thus developing terraces. Its waters seem to have covered the entire area of the present bottoms, and it probably steadily lowered this entire belt to the low grade noted above without developing any intermediate flat. It seems not improbable that the valley bottom had been eroded to the level of the 460-470 foot terrace already described, before the advent of the lake waters. In this event, and accepting Cooley's estimate of the amount of filling that has occurred since the lake waters were withdrawn, the Outlet river lowered the bottom of the middle valley some 55 to 60 feet. The vigorous erosion of the Outlet river is reflected in its steep banks. These have suffered least modification where formed by the till of the valley wall, and such sections of the bluffs are in general steeper than those behind the terraces.

Having developed a very gentle slope, the lower Outlet river must presently have come to meander, pushing back the sides of the valley and extending its flat. This would have invited the final destruction of all the terraces. It was only prevented by the early withdrawal of the lake waters.

The terraces remain for the most part in positions somewhat sheltered from the attacks of the river. The Hennepin terraces have a protected position on the inner side of the great bend. The other large terraces, with the exception of those near Henry, occupy expansions of the valley, immediately down stream from defending projections of the valley walls.

That the Outlet river was of great volume compared with its tributaries is indicated by the fact that the width of its channel increases very slowly down stream.

Wisconsin loess.—The Wisconsin drift of the area under consideration received a partial covering of loess, which, in its typical development, closely resembles the Iowan loess described on page 34. It has been removed from many erosion slopes, and inland gives way to the black earth of the upland prairies. Plate 10 shows a typical exposure of loess at the mouth of Hicks' Hollow, southwest of Chillicothe. The loess (or loess-like silt) mantle has an average thickness of two to six feet, though in numerous places it reaches ten to fourteen feet. The bulk of the thicker deposits is a buff-colored calcareous silt, often containing many lime concretions (Plate 8, B) and shells of mollusks. The weathered surface zone, two to four feet in depth, is brown and leached of its limey constituents. This phase, a brown clayey earth, is that generally seen over the upland. Thanks to its presence, the surface of the Wisconsin drift is generally free from stones.

The origin of the Wisconsin loess is in doubt. The fact that the surface of the till beneath the thicker loess is unleached, seems to indicate that its accumulation began rather promptly upon the disappearance of

Exposure of loess at mouth of Hicks' Hollow, southwest of Chillicothe.

the ice. Westerly winds might be expected to bring fine material in quantity from the loess covered Illinoian drift plain. The Iowan loess, however, had been leached to a depth of several feet before the advent of the Wisconsin ice, as indicated in the discussion of the section given on page 27. Wind-blown material from its surface should therefore be non-calcareous, whereas much of the Wisconsin loess is highly calcareous. This demands another source for at least the major part of the Wisconsin loess. As indicated above, the drainage from the Shelbyville ice edge is known to have been generally feeble, and such may have been the case in places from the Bloomington ice, though along the Illinois valley the gravel deposits imply vigorous outwash. Silt washed out from the ice by sluggish waters might subsequently have been carried back over the body of the drift by the prevailing westerly winds. The surface of the Wisconsin till sheet itself may have been an important source of loess, before it was covered with vegetation. A possible source for some of the loess-like silt is found in the work of earthworms. These animals are continually bringing large quantities of fine material to the surface. This is only a minor source, for otherwise similar silt should appear over wide areas where absent.

The loess has probably been subject to much redistribution, as shown by its occurrence on certain lower erosion slopes developed in the Wisconsin drift.

CHAPTER IV.

POST-GLACIAL CHANGES.

Introduction.

Since the final withdrawal of the ice sheet, the drift-covered surface of this area has been exposed to the chemical and mechanical action of the atmosphere, to the work of running water, and to the influence of various forms of life. It should not be assumed that the changes discussed in this chapter as post-glacial all took place after the final recession of the ice sheet from the United States, or even from Illinois. The changes affected in any given place by air and water began as soon as that place was abandoned by the ice. The latest stage in the development of the region has accordingly been of very unequal length in its different parts. It has probably been several times as long in the area of the Illinoian drift as in that covered by the Wisconsin ice, and has been much longer in certain parts of the latter area than in others.

The changes wrought by the Chicago Outlet river might be considered as post-glacial. Since the very existence of the Outlet river was dependent upon the presence of the ice to the northeast, however, it has been discussed in the chapter on the Glacial period. The work of the minor streams is discussed for the most part in the present chapter, though it began in the southern part of the area while the ice still occupied the northern part and was influenced for a time throughout the area by that of the Outlet river.

Conditions Affecting Erosion.

The freshly exposed drift surface furnished conditions of erosion differing in important ways from those of the present.

The streams, even aside from the glacially swollen Illinois, were doubtless of much greater volume than at present. The vast ice sheet to the northeast chilled the westerly winds, and probably compelled them to relinquish much moisture which otherwise would have been carried farther east. This influence of the ice doubtless extended many miles west of its edge. Slope wash and stream transportation were also greatly favored by the loose character of much of the surface material, and by the absence of protecting vegetation. Wind transportation was favored by the lack of vegetation, but hindered by the rainfall, and during the long winters by the fact that the frozen ground waters cemented the surface material into a compact mass.

WIND WORK.

Wind work within the area under discussion has been largely transportation and deposition. Wind borne particles colliding while in transit, or blown with force against the surface of the ground, have doubtless affected some wear, and have been worn themselves. On the whole, however, wind wear (*abrasion*) appears to have been relatively unimportant.

Strong winds transport great quantities of fine particles the size of dust or loess, often long distances. Frequently raised by ascending air currents well above the ground, such material settles independently of surface objects, forming a layer of more or less uniform thickness. This may help to explain the distribution of the loess, referred in large part to the wind in the preceding chapter.

Sand grains are too heavy to be lifted much above the ground or to be carried far by ordinary winds. Sand, and sometimes even fine gravel, is rolled by the wind along the surface, however, or carried short

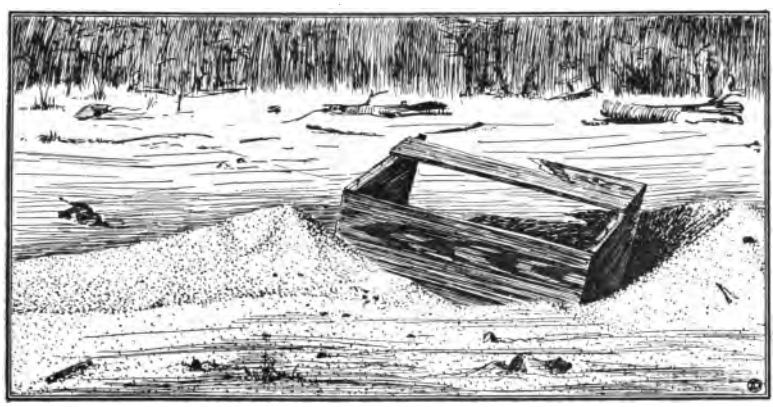


FIG. 30. Sketch showing how wind-blown sand accumulates about an impenetrable obstacle. The wind which deposited the sand came from the left. Lodgement against the box is prevented on both the windward and leeward sides by wind eddies. (Sketched from photo by Bastin.)

distances in its lowermost strata. In these positions it is likely to lodge about obstacles in its path, forming mounds or ridges. Such elevations of wind accumulated sand are *dunes*. Dunes are extensively developed within this area, as indicated in Figure 3. Figure 30 suggests the manner in which sand begins to accumulate about an impenetrable obstacle. Once started, the hillock itself acts as a barrier to other sand, and so occasions its own growth. Where there are clumps of vegetation, they may likewise intercept drifting sand, and cause the formation of dunes. The way in which sand gathers in and about vegetation is frequently illustrated along the thick-set osage orange hedges of the terraces; the major deposit is on the leeward side of the hedge.

The dunes range in height from a few feet up to thirty or forty or more feet above their immediate surroundings. Commonly in the form of irregularly roundish mounds, they are sometimes relatively long and narrow ridges. This is the case locally north of Hennepin and south of Spring Bay, where the ridges extend northwest and southeast, or at right angles to the prevailing southwest winds. Figure 31 shows a typical dune in cross section. The longer and gentler side faces the dominant wind, and serves as a roadway up which sand is carried and rolled to the

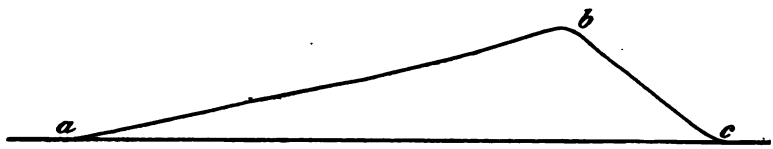


FIG. 31. Cross section of a sand dune. The gentler (*a b*) slope is the windward side of the dune; the steeper (*b c*) slope, the leeward side.

crest, where it falls down the steep slope. The windward slope tends to adjust its steepness to the strength of the wind. Weak winds, especially if handling coarse sand, require a gentle grade; strong winds, particularly if favored by fine sand, can carry their load up a steeper slope. The leeward slope is limited in steepness by the angle at which the material will lie. Since the direction of the winds frequently changes in the region here considered, the dunes are generally much less regular in form than shown in Figure 31.

If, as often happens, the wind is able to move more than it is carrying when it begins the ascent of a bare dune, it removes sand from the dune surface and rolls or carries it to or toward the crest. By the continued transfer of sand from the windward to the leeward slope, the dune slowly shifts its position. It is evident from the nature of this migration that only an extremely small percentage of the sand is in motion at any given time. Plate 11, A shows a dune that is slowly advancing into Meyers lake, near Pekin.

In certain of the dune areas of the region, notably near Pekin and Chillicothe, basin-like depressions among the dunes are quite as distinctive of the topography as are the elevations (Plate 11, B). Such depressions may result from the wind scooping out the sand, or from more sand being deposited around than on a given place, which therefore comes to stand below its surroundings. In a few cases, also, dunes appear to have invaded shallow valleys, whose unfilled portions remain as depressions without outlet. Locally the dune topographies of the area rather closely resemble terminal moraine topography (Fig. 22); the constitution and structure of the hills will enable the student to readily distinguish between them.

While most of the dunes are confined to the terraces from which their sand was derived, a few have migrated to the eastern bluff slopes and uplands, where they appear at intervals all the way from Pekin to Hennepin (Fig. 3). They are confined to the eastern bluffs because the

A. Sand dune advancing into Meyers lake, near Pekin.

B. Depression in wind-blown sand near Pekin, containing pond.

prevailing winds are from the west; on the west side of the valley the winds blow from the uplands to the sandy terraces, while on the east side they blow from the source of the sand to the uplands. The dunes along the eastern bluffs are best developed back of the terraces. This may mean that the bulk of the upland dune sand was carried there after the partial removal of the valley drift; in that event it would apparently illustrate the importance of the factors that at first inhibited the work of the wind (p. 50).

There is much sand along the bases of the steep bluffs opposite Henry and Chillicothe, some of which appears to be wind lodged, that is not aggregated into distinct dunes. The steepness of these slopes would, apart from the existing vegetation, possibly prevent the sand reaching the uplands. Winds can carry sand to any height up gentle slopes, but are unable to carry it up very steep slopes. The dune areas of the region are in general under cultivation.

Work of Running Water.

POST-GLACIAL AGGRADATION BY THE ILLINOIS RIVER.

The transporting power of a stream is dependent upon its velocity, which in turn is controlled by its gradient, volume, load, and the shape of its channel. The influence of a high gradient and of great volume is evident; both invite rapid flow. The load which a stream transports reduces its velocity, for the energy expended in moving the detritus would otherwise be available for flowing. Lastly, a stream is retarded by friction with its bed and banks. The greater the cross section of the channel, and the more irregular and crooked the bed, the greater the amount of energy expended in overcoming friction.

The Chicago Outlet river, because of its great volume and the fact that it left the lake essentially free from sediment, was able to reduce its lower channel to an extremely gentle slope and still carry away all the material brought to it by tributaries. When the discharge from the lakes was withdrawn from the Chicago Outlet, the Illinois river was suddenly reduced to a small fraction of its former volume. This reduced its velocity and hence its carrying power to such an extent that in the section of low slope below Utica it was unable to transport the material delivered by its tributaries. This detritus was accordingly dropped along its valley floor, together with that derived from its upper course, where a steeper gradient enabled the river to continue, though much more slowly, the erosion of its predecessor. The amount of post-glacial filling along the middle Illinois has been estimated by Cooley to average thirty feet. The result of this filling is the present flood-plain.

By aggradation a river tends to develop a steeper grade, along which it may wash its load. If the post-glacial Illinois has built up its valley bottom thirty feet, it is remarkable that it still has an average fall of only a trifle over four-fifths of an inch per mile between Hennepin and Pekin, indeed it is difficult to see how even the Outlet river could have

developed so low a gradient. The steepening of a river slope, so far as it is due to deposition, of course depends upon more rapid deposition in its upper than in its lower part. Possibly the failure of the lower Illinois to appreciably increase its grade is to be explained in part by relatively large contributions of sediment from its lower tributaries. It has been suggested that the northern part of the Illinois valley may have been depressed. The great weight of the ice sheet has been thought to be a possible cause, while the heavy deposits of drift may have prevented a complete return to the former attitude after the disappearance of the ice. Such a movement was suggested by the fact that deep borings apparently showed the rock floor of the pre-glacial Illinois valley to be as low at Princeton and Hennepin, as at Peoria, fifty miles down stream. It is by no means certain, however, that these borings discovered the lowest point in the old valley. It has been further suggested that the low slope of the lower Illinois may not be due wholly to erosion by the Outlet river, but in part to the suspected movement. The last suggestion seems hardly applicable, since the downward movement, occurring before the Outlet river came into existence, could affect only the slope with which the river began its work, not that which it subsequently developed. To explain in this way the present low grade of the river, very recent movement must be assumed.

The history of the Illinois flood-plain, already referred to, is in contrast with that of normal valley flats. As an eroding river approaches base-level, its diminishing gradient compels it to flow less and less swiftly. Finally the sluggish current is diverted by the deposits or currents of tributaries and by various obstacles from the relatively direct course maintained during its more vigorous youth. Striking its banks at various points, it cuts them back. The points of attack shifting from time to time, the flat is widened generally, and a flood-plain is developed upon which deposits may subsequently be made by the stream in periods of overflow. Thus flood-plain flats are ordinarily developed first and primarily by lateral erosion, and secondly and subordinately by deposition. The Illinois flood-plain, on the other hand, is the product of deposition upon a flat not formed by lateral erosion. Its width is essentially that of the Outlet river, which, as we have seen, had not begun to meander when its career was cut short. To be sure, aggradation by the present stream has slightly increased the width of the valley bottom, since any valley whose walls are not vertical is wider at any level than at any lower one. The present river may also have undercut its bluffs locally to slight extent.

Normal valley flats are widest in their lower portion, where the gentle gradient that invites lateral shifting was first formed, and narrow somewhat regularly up stream. The irregular width of its valley was of course inherited by the present Illinois river. The constriction at Peoria is probably due to the moraine which crosses it at that point. The cause of the relatively narrow sections near Lacon is not apparent. They may be due to the influence of resistant rocks, though this is not demonstrated. In the western bluffs, bed rocks are thinly covered with

drift, as indicated by outcrops and by numerous coal drifts. There is, however, no evidence of their presence in the opposite eastern bluffs. The very striking narrowing of the valley in the vicinity of the great bend is explained by the lesser age of the narrow section. Below the bend the river is within the great Rock-Illinois pre-glacial valley; above the bend it follows (Leverett) the course of a small pre-glacial tributary which headed near Utica. Furthermore, at Marquette, and on the opposite side of the valley near Mud Lake, relatively resistant bed rocks appear in the bluffs and lower ravine slopes.

The structure of the flood-plain deposits, and the incipient levees of the river were described in the first chapter.

FLOOD-PLAIN LAKES.

The lakes of the middle Illinois flood-plain range from Lake Senachwine (Fig. 9), over four miles in length, to small ponds. Like many of the other features of the valley they appear to differ somewhat from the ordinary representatives of their class. Plate 12, A and B may illustrate the usual manner in which flood-plain lakes are formed. Such a meandering stream tends to erode along the outer edge of its curves, where the current is relatively swift, and to deposit on the inner edge, where the water is slack. Finally the stream cuts through the narrowing neck of land between the two limbs of a meander, as shown in the middle distance of Plate 12, B, at "A." The current abandons the old round-about course, which is likely to be isolated by the shifting of the stream to another position upon its flood-plain, or by deposition at the ends of the abandoned meander, whose standing waters check the edge of the current. Such lakes are usually cresentic in form and are called *ox-bow lakes*. In the summer of 1907 an ox-bow lake was in process of formation in the lower course of Kickapoo creek. A number of them may be seen along the lower Mackinaw, where the formation of others appears imminent. The lakes of the Illinois flood-plain are clearly former sections of the river, but they have not the curved outlines of typical ox-bow lakes. Lake Senachwine, shown in Figure 9, is a striking illustration of this. The river appears to have broken from its partially filled channel in flood time, to follow a slightly lower line through the adjacent bottoms. Since there are many lakes upon the flood-plain, numerous changes in the position of the river are recorded. The fact of frequent shifting was seen in Chapter I to be indicated also by the structure of the flood-plain.

The lakes are being gradually obliterated as indicated on page 6, (1) by the encroachment of marsh vegetation upon their shallow borders, (2) by wash from the surrounding land, and (3) by wind-blown material. Many of them probably retain but a small fraction of their original size and all are temporary features. Doubtless many former lakes have been destroyed and the existing ones will be replaced by others in the future unless the river is artificially confined to its channel.

The lake-like expansions of the river itself were explained in Chapter I.

HISTORY OF THE SMALL VALLEYS.

The opportunities along the middle Illinois for the study of valley development are unsurpassed. Tributary valleys are crowded together on both sides of the river. Attention is now directed to their history. Many of the processes involved in their formation have been discussed in other connections in preceding pages.

The beginning of the valleys.—If the slopes leading to the Illinois valley at the withdrawal of the ice sheet had been of uniform steepness and composition, and the rain that fell upon them had been everywhere equal, the run-off, and the quantity of earth washed down slope by the run-off, would have been equal along all lines. Doubtless none of these conditions existed. The slopes were more or less irregular, and the run-off therefore uneven. Where more water descended, its velocity was greater and it eroded faster than elsewhere, forming a depression. The surface materials of the slopes varied from point to point in size and compactness. Where the particles were small and not compacted, they were removed more readily than at other places, the result being as before, a depression. These depressions were *gullies*. Gullies (miniature valleys) then, are depressions in the land begun by the erosion of running water in consequence of inequalities in slope or in material.

Plate 13, A, shows a typical gully. Water that in the future runs down slope into this gully will wear its head back into the upland. Rain wash down its sides will widen it. Erosion by water flowing along its bottom will deepen it. Gullies grown sufficiently long and wide and deep are called ravines, which in turn may grow into valleys.

The origin of the streams.—A part of the rain sinks into the ground, which at a varying distance from the surface is full of water. The surface of this ground water is the *water table*. When the bottom of any ravine is worn below the water table, water seeps into it from the sides, and would fill it to the surface of the water in the adjacent rocks, were the water not continually flowing away as the stream. In addition, streams receive water that falls as rain on their surfaces, and that runs directly from the tributary slopes. All the permanent streams of this area, however, are maintained primarily by the issuance of ground water along their lower valley sides.

The position of the water table is not constant. It rises during periods of rain and falls in times of drought. Ravines whose bottoms are below the water table when it is high, but above it when it is low, contain *intermittent streams*. Most of the streams of this area are of this class. Furthermore, the small valleys which possess streams in their lower portions are without them near their heads, where they have not reached the water table. Certain valleys, too, which extend from the clay uplands across the Illinois terraces to the river, have permanent streams in the uplands, which wither and disappear on reaching the terraces. This is because the lowest position of the water table in the porous sands and gravels of the terraces is almost at the level of the river.

A. A meandering stream. (Photo by Neal.)

B. Meandering stream and ox-bow lake. (Photo by Neal.)

Once a valley has acquired a permanent stream, it grows more rapidly than before in all dimensions, becoming steadily deeper, wider, and longer.

The deepening of the valleys.—Since within this area the bottoms of most of the valleys are in drift, the smaller material along their stream channels is readily removed. Fine sediment is often carried in suspension by upward moving currents, formed by projections of the bed or banks. Somewhat larger material is rolled or dragged along the bottom. When bowlders too large to be moved by the current are discovered in the till in which the valley is cut, they must remain upon the floor of the channel until worn to a size within the capacity of the stream.

A few of the ravines of the area are floored in part with firm bed rock. Clear water has little effect upon such material, but the sand and gravel carried by the stream rub and strike the bottom, and from time to time wear or break off bits of rock which are carried away by the current.

The fact has been pointed out in earlier connections that as a stream lowers its channel, erosion becomes slower, for the slope of the channel and in consequence the velocity of the current, are steadily reduced. Finally a gradient is reached below which the stream cannot cut. It is then said to be at grade. This represents a balance between transporting power and load, the slope being just steep enough to give the stream the velocity necessary to transport its load. It is evident that the slopes of channels at grade vary in steepness. Large streams with relatively little loads develop very gentle slopes before reaching grade. The Chicago Outlet river, discussed above, is a remarkable example. Smaller streams with relatively large loads find themselves at grade on steeper slopes. From this it follows that a given stream flowing over a slope without cutting or depositing may not remain at grade; if its volume is increased or its load decreased, it will cut to a lower and gentler slope, while if the opposite change in volume or load occurs, it will develop a steeper channel by deposition. There is thus a limit below which the small valleys of the region cannot be cut. At their mouths this is the level of the larger valleys to which they lead; upstream from this point it is a gentle gradient to which no definite degree of slope is assignable.

Many small valleys have been cut with reference to an Illinois valley terrace, rather than the Illinois flood-plain, as a base-level. Such valleys are of course less deep than those whose mouths are at the level of the river.

The widening of valleys.—The development of a valley flat by the side cutting of its stream was discussed on page 54, in connection with the flood-plain of the Illinois river. Vertical erosion often continues slowly after active side cutting begins. This has led to the formation of terraces along many of the small valleys of the area. From the discussion of preceding pages it will be understood that such terraces are likely to be destroyed by side cutting at lower levels. While valleys are ultimately widened chiefly by the lateral erosion of their streams (Plate 13, B), other processes aid that have been in operation from the begin-

ning. (1) Each rain washes material down the sides. (2) Masses of earth sometimes slide (*slump*) down the sides of the valley. Slumping is particularly common with clay, which during heavy rains becomes both heavy and slippery (Plate 14, A). (3) Material near the surface moves slowly down the side slopes by a process called *creep*. Earth particles expand under the heat of day, and chiefly down slope, for gravity assists downward movement, while it opposes expansion up slope. When the particles cool they contract, and largely from their upslope ends, since this again involves movement with, rather than against gravity. The result of many expansions and contractions is an appreciable movement toward the valley bottom. When the valley sides are of clay, creep is invited in another way. As it drys after rains the clay shrinks and cracks, forming the familiar sun-cracks. Because of the influence of gravity, the opening of a horizontal crack is largely the result of the down-slope movement of the clay below, rather than the up-slope movement of that above. With the first shower the clay swells and the crack is closed. Under the influence of gravity it is closed chiefly from above rather than from below. Repeated shrinking and swelling means very slow movement down slope. The trees of almost every valley side within the area lean down slope because of creep. The surface material creeps faster than that at a slight depth, tipping the trees toward the axis of the valley (Plate 14, B). (4) Winds may blow the material from the sides of valleys, thus slightly increasing their width. Certain other less important ways in which valleys are widened need not be discussed here.

If the sides of a valley are of unequal resistance, they will recede at unequal rates and if they vary sufficiently, the valley may become wide in some places, while still narrow in others. This is strikingly illustrated in the case of the lower Kickapoo valley, near Peoria. The "Horseshoe Bottom" has been opened in drift, while the notable constriction just below is in Pennsylvanian rocks.

There are limits to the width which a valley may attain, just as there are to its depth. These limits are set by the next valley upon either side. The widening of adjacent valleys may destroy the divide between them, however, the two then becoming one. This possibility is illustrated near the right hand side of Plate 15, A, where two gullies are rapidly consuming the narrow ridge which separates them. The larger gully formed by their union may in turn unite with the gully next to the left. The final outcome of this process among valleys would be the reduction of the entire area to the level of the valley floors.

The lengthening of valleys.—This is not accomplished by the permanent stream, which, as noted above, begins some distance below the head of the valley. All the other agencies which widen valleys, tend also to lengthen them, rain wash being most important.

The valley head is carried back into the upland in the direction of greatest erosion, and this is determined by the slope of the surface and by the character of the material. If the slope in which a valley heads is uniform and the material everywhere the same, most water will enter

A. A young gully near Lacon. The material removed in the formation of the gully is spread upon the flat in the foreground, forming an alluvial fan.

B. Crow creek, west of Henry, widening its valley by lateral erosion. (Photo by Crane.)

the valley from straight up slope and the valley will extend itself in that direction. More often minor irregularities of slope bring the major part of the run-off tributary to the head of a valley first from one direction and then, after a longer or shorter interval, from another. The line of least resistant material may also extend in different directions at different times. For these reasons the courses of most of the small valleys are irregular.

Peculiarities in the courses of certain valleys were pointed out on pages 43-44. Senachwine creek (the one north of Chillicothe) also follows an interesting course. Instead of flowing east by the shortest line to the Illinois in the vicinity of Sparland, as might be expected, it flows south for several miles parallel to the main valley, and finally empties near Chillicothe. The explanation is found in the presence of a minor morainic ridge southwest of Sparland, which extends roughly north and south. The Senachwine flows around this ridge to reach the Illinois river. Morainic ridges also influence the courses of some of the streams shown on the Hennepin quadrangle. Big Bureau creek flows south past Princeton along the edge of the Bloomington moraine; west of Tiskilwa a curve in the moraine turns the creek sharply to the east, to meet the Illinois at the great bend. The parallel courses of East Bureau and Brush creeks appear to be determined by minor ridges.

A valley ceases to grow by headward erosion only when stopped by rival drainage in the opposite direction. If the material upon which opposite flowing streams work is the same, the divide between them ceases to shift horizontally when the opposing slopes are of equal steepness. Thus the growth of any given valley within the area is limited in all three dimensions; in depth by the level of the valley to which it leads, and in width and length by rival valleys. A further point concerning the lengthening of the valleys in this area is worthy of note. All have been lengthened by headward erosion; some of those which are directly tributary to the Illinois valley have been lengthened also at their lower ends. When the Illinois river, flowing at the level of one of its terraces, shifted toward the center of its valley from a position near the bluffs, it was followed across the flood-plain by the permanent streams that entered it on the side from which it withdrew. When the Illinois later lowered its channel into the flood-plain, forming the terrace, the extended tributaries were enabled to cut valleys in the terrace, which differed from the older upland sections in several respects. They were of course less deep, and the streams preceded the valleys, all parts of which are of the same age.

Struggle for existence among ravines.—It is not to be inferred from the foregoing paragraphs that all gullies become valleys, or even ravines. Quite the reverse is true. Few of the gullies shown in Plate 15, A, for example, can grow to ravinehood. As they widen, the intervening divides will be worn out, combining adjacent gullies and reducing the number. Some of the larger gullies are already invading the slopes above their shorter neighbors, thus capturing the run-off which otherwise would go to the latter, whose headward growth is likely to be cut short. Such a group of gullies may be entirely destroyed in the formation of a single

ravine, which will in turn presently find its growth contested by other ravines. Such a conflict is shown in Plate 2, among the ravines near Wesley. Little opportunity for growth remains to most of the ravines in the vicinity, and many are doomed to destruction by their more powerful rivals.

Tributary valleys.—Most of the small valleys of the area have tributaries. They began in the same manner as the parent valleys. If more water from the sides entered at certain points than at others, because of inequalities of slope, it flowed faster and eroded more rapidly at such places than elsewhere, starting gullies. The same result was achieved if the material of the valley sides was less resistant along certain lines than along others. The first generation of tributaries usually developed tributaries of its own, and in many cases the process has been repeated a number of times.

Stages in valley development.—Since valleys increase in size as they advance in years, it has been found convenient to adopt certain terms descriptive of the several leading stages in their development. *A young valley* is one that is still narrow and steep-sided; it is generally short and often has a relatively steep bottom and poorly developed tributaries. A *mature valley* is wider and deeper and longer; in cross section it has become U-shaped, rather than V-shaped; its gradient is less steep and its tributaries more numerous and better developed. An *old valley* is shallow and wide, with a low gradient and gently sloping sides. Corresponding terms are applied to regions as a whole. An area is in the youthful stage of its development when its valleys are young, and extensive interstream areas are untouched by drainage lines; most of the work of reducing the area to baselevel (p. 23) remains to be done. An area is mature when thoroughly dissected with valleys, so that slope is at a maximum. Finally, an area is old when it has been reduced to a low, flattish plain, with broad, shallow, flat-floored valleys.

With the exception of the Illinois, the valleys of the area under consideration are all young, for they are all narrow and steep-sided. They represent various stages in youthful development, however, a fact clearly shown by Plate 2. This is because some were begun earlier than others, and also because water was received from a larger area, and the rocks were less resistant in some cases than in others. The middle Illinois valley may perhaps be taken to represent late maturity; so far as the width and slope of its flood-plain are concerned, it is old, but the valley sides are still high and steep. This combination of characteristics belonging to different stages of erosion is a consequence of the peculiar history of the valley. The great discrepancy in age between the middle Illinois valley and its tributaries is explained by the fact that the former was developed by a powerful river fed by the ice sheet and the temporary lakes in its upper valley (p. 46), and by Lake Chicago, while the latter were formed by very small streams, most of them intermittent.

North central Illinois, taken as a whole, is in a youthful stage of development. Limited areas bordering the middle Illinois valley are so dissected by small valleys as to be nearly all slope, and are therefore

A. The widening of a valley by slumping.

B. Creep on a ravine side shown by leaning trees.

mature. But outside the Illinois valley and the adjacent ravine land, the work of reducing to base-level the surface left by the ice has been scarcely begun.

Influence of Illinois river upon configuration of small valleys.—We have seen (p. 57) that the small valleys cannot be eroded below the level of the Illinois valley, and in connection with certain valleys in the Illinoian drift (p. 44) that deposition by the main river compels deposition by its tributaries. Some of the larger tributary valleys appear to have developed with reference to the Illinois valley when the ice sheet still lingered in the northern part of the area. Later, when the Outlet river lowered the main valley, the tributaries were able also to degrade their channels actively. The effect was of course felt first at the mouths of the tributaries, and the new gradient established there extended itself upstream by headward erosion. When this extension was only partly accomplished, the lakes ceased to discharge to the southwest, and the Illinois commenced to aggrade its valley. This of course forced the tributaries to deposit near their mouths, and as noted under the following heading, deposition is still in progress there. The result of these changes is that many of the larger tributary valleys have steeper gradients in their lower than in their upper courses. This is especially well shown on the Metamora quadrangle, which extends east of the river far enough to include the heads of a number of large ravines. Figure

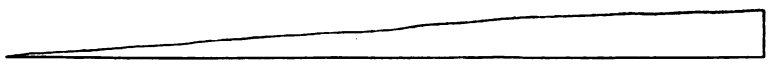


FIG. 32. Profile of Dry Run creek, east of Chillicothe.

32 shows a profile of the bottom of Dry Run creek, east of Chillicothe; the gentle slope of the upper valley is in sharp contrast with the steeper slope of the middle and lower valley. In contrast with this, valley bottoms normally become increasingly steep headward.

Building of alluvial fans.—The condition of the Illinois also compelled its tributaries to build alluvial fans. The alluvial fans of the middle Illinois valley were described in Chapter I as among its more striking and peculiar features, and their influence upon the position and width of the river discussed. They occur both upon the flood-plain and the terraces of the Illinois at the mouths of practically all the tributary valleys. Their size corresponds roughly with that of the valleys which they front, and varies from that shown in Plate 1, A, and Plate 13, A, to hundreds of acres. The building of alluvial fans began along the Illinois flood-plain upon the loss of the overflow from the Great Lakes. The Outlet river covered the present flood-plain and carried away all the material brought down by the tributaries; the Illinois occupied but a fraction of the old channel, and began at once to deposit. The velocity and hence the transporting power of a tributary was promptly checked when it left the relatively high gradient of its own valley (developed in response to the erosion of the Outlet river) to enter the flat floor of the Illinois valley. The resulting deposit choked the channel of the

tributary, and some of the water spread to right and left of the obstruction. The process being repeated many times, and the stream meanwhile extending the deposits in the direction of its flow, they acquired more or less of the "fan" shape, which is characteristic of such deposits, and which suggested their name. Many of the larger fans are characterized in their outer portions by water channels which give off branches that in turn repeatedly divide. The explanation of these branching channels (*distributaries*) is involved in what has already been said. Deposition in a given channel reduces its capacity until some of the water breaks over the side and follows an independent course to the margin of the fan; the new channel becoming choked, gives off other distributaries, and so the process is repeated. The spreading of the water flowing over the fan becomes in itself an important cause of deposition, because it increases the friction of flow, and therefore decreases the velocity. Deposition is also caused by the fact that frequently much or all of the water sinks into the porous material of the fan. Thus the growth of the fans is due to (1) decrease in gradient, (2) increase in friction of flow, and (3) decrease in volume.

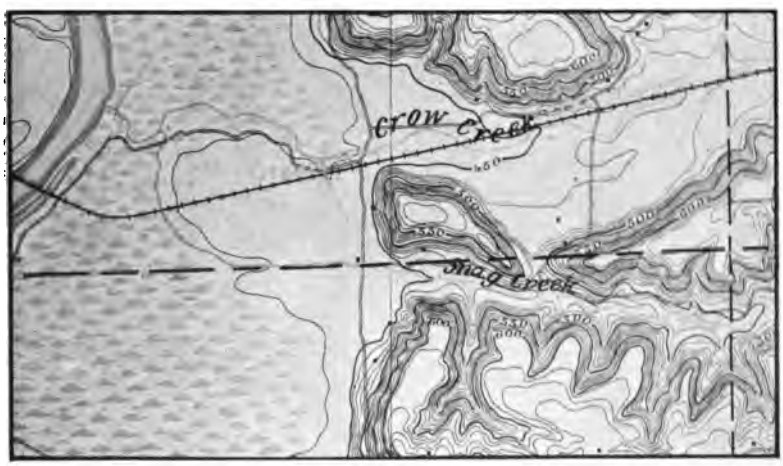
The distribution of the material in the alluvial fans is worthy of note. The coarsest material is dropped at the apex, where the stream is first checked, and the deposit made at any given time becomes progressively finer toward the margin. This does not mean that a vertical section through an alluvial fan, all parts of which are at the same distance from the apex, would show material of the same degree of coarseness. On the other hand, the material would be likely to change frequently both horizontally and vertically, for the volume (and so the transporting power) of different distributaries would vary at the same time, and of any given distributary at different times. Such variations near the tops of various fans may be seen in the walls of the channels which cross them. Great variations are shown also in a series of borings made by the Peoria Water Works Company in the fan of Ten-Mile creek.

The angles of slope of fans depend upon how suddenly and how much the velocity of the depositing waters was reduced, and upon the kind and amount of material they carried. A sudden and great reduction in the velocity of a stream heavily loaded with coarse material, gives a relatively steep slope; the opposite combination a gentle one. In general, the smaller, intermittent streams have built relatively steep fans, while those of larger streams, such as Farm creek (Fig. 13 and Plate 2), have low slopes. Like other depositional slopes (see Fig. 12 and Plate 4, B), the profile of a fan along any radius is a curve concave upwards. This may be readily seen in the smaller fans (Plate 1, A). The fans located upon the Illinois flood-plain would be even more conspicuous were it not for the up-building of the flat which surrounds them.[1]

Changes in stream courses.—There are a few examples within the area of sections of valleys that have been deserted by the streams which

[1] Some idea of the rate at which Farm creek has extended its deposits may be gained from the following: "This lake (Lake Peoria) was twenty-five years ago much wider at the lower end, but since that time the little Farm creek has formed about a hundred acres of alluvium just opposite the middle part of the city." (History of Peoria County (1880), p. 293.)

A. View illustrating struggle for existence among gullies.



B. Map showing stream piracy east of Chillicothe. (Portion of Metamora topographic map, U. Geol. Surv.)

once occupied them. One is shown in Plate 15, B. The depression between the valleys of Crow creek and Snag creek, through which the wagon road passes, was clearly formed by running water. That Snag creek formerly flowed through it into Crow creek, and not Crow creek to join Snag creek, is strongly suggested by the trend of the bluffs on either side of the depression. A small tributary of the Illinois, occupying what is now the lower portion of the valley of Snag creek, appears to have worked back by headward erosion until it reached Snag creek, which it diverted to its present course. Similar changes in drainage have occurred on a vastly larger scale in various parts of the Appalachian mountain region. A stream which accomplishes such a diversion is known as a *pirate,* and the process as *stream piracy.*

A change has taken place in the course of Big Bureau creek two miles northwest of Princeton. A few other drainage changes have occurred elsewhere in the area.

Other Post-Glacial Changes.

In addition to the matters noted above, various less conspicuous, but not unimportant changes have been in progress. The wind has shifted much fine material about, of which no record is preserved in surface features; an unknown, but doubtless large amount has been carried entirely outside the area, but on the other hand, a large quantity has also been imported. Rains have washed vast quantities of earth from higher to lower levels; their efficiency is shown, for example, in the reduction of certain sections of the Illinois bluffs (Plate 4). The oxygen of the atmosphere has entered into combination with the iron of the upper till, producing its characteristic reddish-yellow color. Ground waters have generally removed in solution the soluble constituents of the till in the surface zone; locally they have deposited material from solution, cementing originally loose drift into compact rock. Earthworms have brought large quantities of fine material up to the surface, making important contributions to the soil. On the flood-plain of the Illinois river and on the flat upland prairie, where drainage is poor, partially decayed vegetation has been mixed in large quantity with the surface material to form rich black soils; on the hilly land just back from the Illinois bluffs, it is removed by erosion, and the yellow soil is less fertile. Locally, as indicated on page 19, deposits of peat are being made on the flood-plain.

CHAPTER V.

THE SETTLEMENT AND DEVELOPMENT OF THE REGION.

Introduction.

Any discussion of the geographic conditions that have influenced the development of the middle Illinois valley must consider many events and places outside the area itself. Thus, for example, steam navigation upon the Great Lakes, the lumber industry of Michigan and Wisconsin, and the Illinois and Michigan canal vitally affected the region. This chapter, therefore, is less local in its discussion than the preceding ones.

One of the most important geographic factors in the history of Illinois is its location between the Great Lakes and the Mississippi river. Throughout the history of the State, the Illinois valley has formed the greatest natural highway between the two. It was followed by the first white men who crossed the State; it became an important highway of the fur trader; and it guided toward the north a great stream of Southern settlers, which met and mingled in the middle valley with a wave of immigration from the East that had followed the valley south from the vicinity of Lake Michigan. Today the counties bordering the Illinois river and its continuation, the Illinois-Michigan canal, contain over one-half (51%) of the population of the State.

Southern Pioneers in the Region.

Illinois is 385 miles in length, extending from the latitude of Lynn, Massachusetts, to that of Newport News, Virginia. Since American expansion has been chiefly westward, along such highways as the Great Lakes and the Ohio river, the State drew its early population from widely separated areas. The southern part was occupied by people largely from the South and Southwest, while the northern portion was settled by immigrants from the middle Atlantic states and New England.

The accompanying maps, Figures 33 and 34, show the advance of southern settlement toward the Illinois valley. In 1820 (Fig. 33) population was confined to the southern portion of the State, and chiefly to the vicinity of the Wabash, Ohio, and Mississippi rivers, and certain

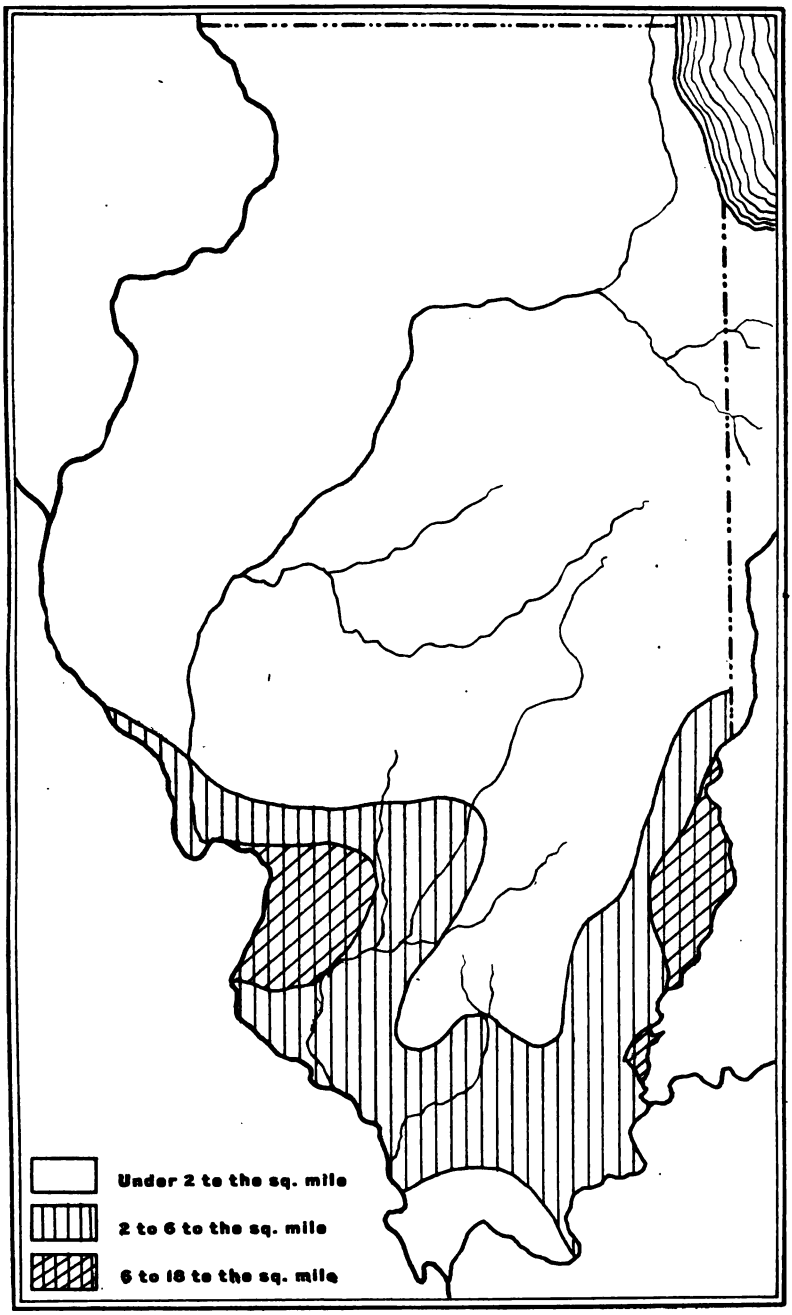


FIG. 33. Map showing distribution and density of population in Illinois in 1820.

of their larger tributaries. Not a man in the constitutional convention that met at Kaskaskia in 1818 came from any portion of the State north of Madison and Crawford counties.[1] In 1819 a farm in southwestern Logan county was thought to be the most northerly in the State.[2] These people had come from the Piedmont Plateau, and especially from Kentucky and Tennessee. The areas of richer soil in the last mentioned states had become overcrowded to the typical frontiersman, who sought cheaper land and freer conditions farther west. A portion of this overflow was insured to Illinois by (1) its extension southward well beyond the northernmost latitude of Kentucky, (2) its nearness, and (3) the various navigable rivers which, leading from the older settlements, focused upon its southern border.

During the next few years, settlement spread northward into the Sangamon region. In 1823, Springfield was a frontier village containing a dozen log cabins; the site of Peoria was occupied by a few families, and that of Chicago by a military and trading post.[3] The rest of northern Illinois was entirely unoccupied. In the latter part of the twenties the Sangamon country filled rapidly, one hundred wagons in a single train being frequently seen on their way there.[4] A new impetus was given to the movement by the establishment of steam navigation on the Illinois river in 1828. By 1830 (Fig. 34) the Sangamon district was overflowing into the Illinois valley, which contained a few settlers well beyond Peoria. Tazewell[5] and Woodford[6] counties had received their first settlers in 1823, Marshall county in 1827,[7] and Bureau county in 1828.[8]

The southern pioneers who settled Illinois were hunters rather than farmers. They were thoroughly familiar through generations of experience with the conditions and problems of forest life, but at their coming knew nothing of conditions on the prairies. Their advance northward was therefore in general limited to the forest area (Fig. 35[9]). They had, however, followed the wooded banks of the Illinois river well into the prairie region. Small clearings in the timber were tilled in an irregular and unscientific manner, and the hunter pioneer was being slowly transformed into the farmer. It appeared likely that the entire Illinois valley and, when the problem of handling the prairies should finally be solved, all the northern portion of the State, would be settled by southerners, and dominated by southern institutions and ideals. Fear of such a possibility, and of its possible political consequences had led Congress to give Illinois its present northern boundary line when it

[1] Ballance: History of Peoria, p. 50.
[2] Ferdinand Ernst: Publ. No. 8 of the Hist. Lib. of Ill., p. 161.
[3] Albach: Annals of the West, p. 993.
[4] Pooley: University of Wisconsin Bulletin, No. 220, p. 89.
[5] Bateman and Selby: Historical Encyclopedia of Illinois, p. 418.
[6] History of Woodford County, p. 227.
[7] Bateman and Selby: Historical Encyclopedia of Illinois, p. 353.
[8] Ibid., p. 67; Matson: Reminiscences of Bureau County, p. 247.
[9] This map, published by Gerhard in his "Illinois as it is" (1857), is about the only one which shows the original distribution of woodland and prairie with any approach to accuracy. Even it, however, is faulty, at least locally, in details. Some attempt, based on local discussions, has been made to correct it in the six counties of the report. Elsewhere it remains unchanged. A statement of the ratio of woodland to total area throughout the state in 1880 may be found in Porter: The West in 1880, pp. 162-163.

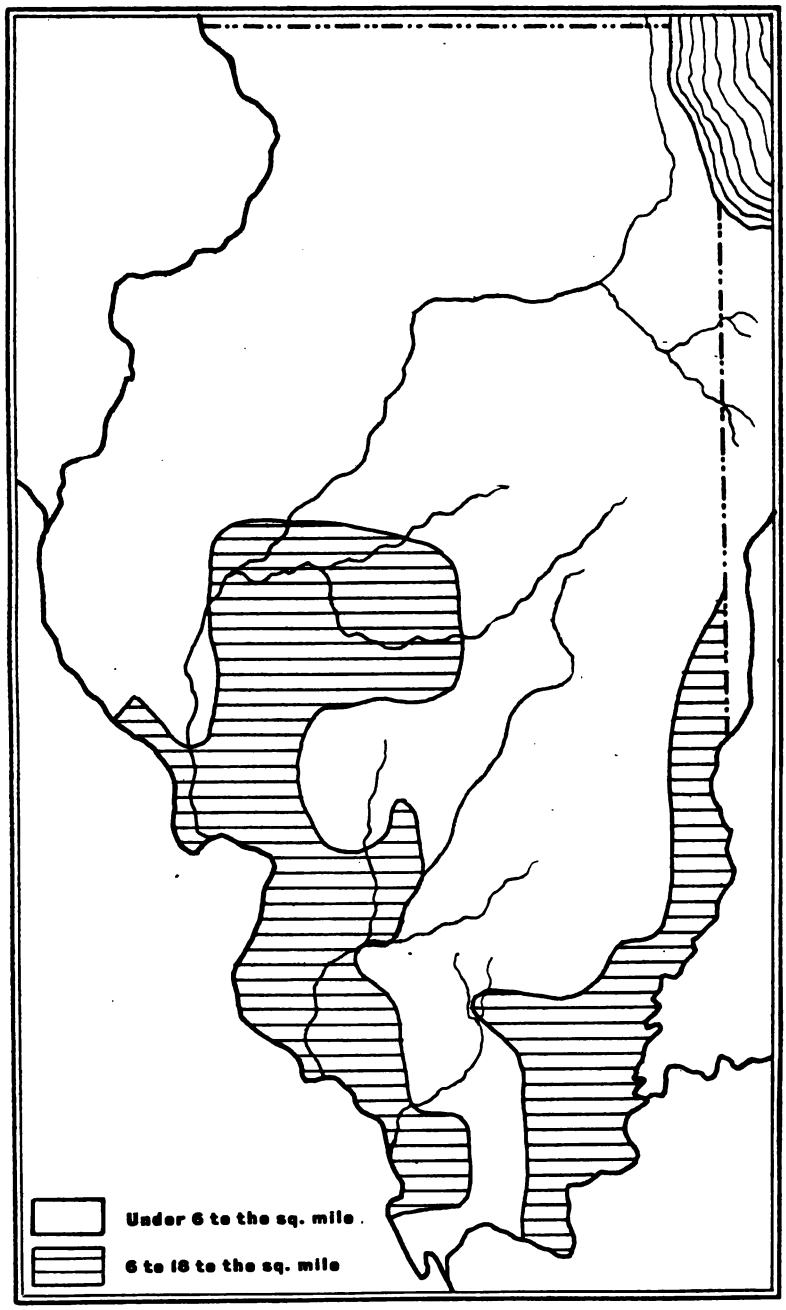


FIG. 34. Map showing distribution and density of population in Illinois in 1830.

was admitted as a State in 1818, in place of the line originally intended, extending due west from the southern bend of Lake Michigan. It was hoped that the fifty miles of frontage on Lake Michigan would give (as it did) the northern part of Illinois many settlers from the northeastern states, and close commercial and political ties with that section.[1] In 1832 the southern advance along the Illinois valley was checked, and, save at Peoria, the settlers were driven south and east of the river by Black Hawk's war. Before the southern frontier had recovered from this blow, a great northern stream of immigration from New York and New England had swept into the unoccupied portions of the valley, occupying first the woodland and later the prairie.

New England Pioneers in the Middle Illinois Valley.

Causes of emigration from New England.—For two centuries New England was dominated by the ocean, its prosperity dependent chiefly on shipbuilding, fishing, and the carrying trade. This section, therefore, took comparatively little part in the westward movement until long after the land-hungry, agricultural south. In the decade 1820-1830, however, an expansion started up actively from New England that was destined to become a movement of great proportions later. Many causes contributed to it.[2] Shipping declined. Agriculture was extensively replaced by sheep and cattle raising in the back-country uplands, and many small farmers found it advantageous to sell their land to stock growers and go west. The lowlands were occupied, and wheat could not be grown with profit on the stony, infertile hillsides, particularly in the face of western competition. Immigrants displaced native workers in many mills. The financial crisis of 1837 combined with crop failures to increase the economic distress. On the other hand, conditions upon the western frontier were very attractive to the struggling New England farmer. In 1820 government land was reduced to one dollar and a quarter an acre in blocks as small as eighty acres. Much larger crops could be grown with much less labor. Furthermore, the expense and time involved in reaching the West were greatly reduced by the opening of the Erie canal in 1825, and the development of steam navigation upon the western lakes in the thirties. These improvements also meant cheap transportation of western grain to eastern markets, once it had reached a lake port. The first emigrants sent glowing descriptions of the western lands to friends and relatives in the East; discontent and restlessness became general, and tens of thousands turned their faces to the west to start life anew. Large contributions to the western population were also made by the states farther south, where economic conditions were also unsatisfactory.

Principal routes to the middle Illinois valley.—Before the opening of the Erie canal, the journey from New England to the West was slow, difficult, and expensive. Emigrants from western New England could

[1] Ford: History of Illinois, pp. 19-24.
[2] Turner: Rise of the New West, pp. 15-16; Pooley: University of Wisconsin Bulletin, No. 220, pp. 44-53.

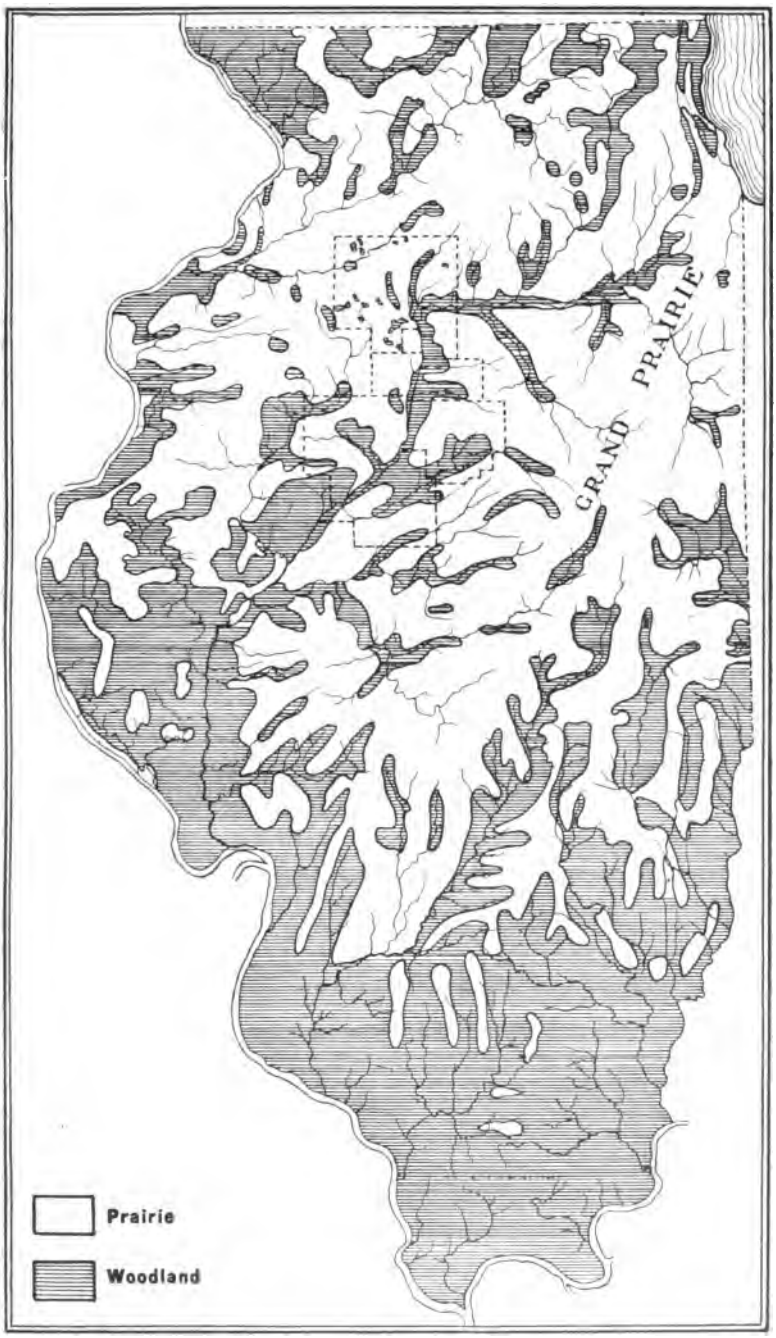


FIG. 35. Map showing distribution of prairie and woodland in Illinois. (Modified from Gerhard.)

use the Mohawk and Genesee turnpike to Lake Erie, or the Catskill turnpike to the upper Allegheny.[1] Those leaving eastern New England usually went by sea to Philadelphia or Baltimore and thence by stage over the Allegheny mountains to the Ohio river. It required twenty-seven days for a party from Boston to come in 1831 to the lower Illinois valley by way of Pittsburg and the Ohio, Mississippi, and Illinois rivers. The household goods, sent from Boston by sea to New Orleans and up the Mississippi river, arrived much later.[2] In 1838, the passenger fare from New York to Peoria by way of Philadelphia, Pittsburg, and St. Louis, involving railroad, canal, and river travel, was forty to forty-six dollars.[3]

The Erie canal promptly became the most important route to Lake Erie in 1825. There were still, however, few vessels upon the lower lakes and none regularly upon the upper, so that various courses were followed from Lake Erie to the Illinois valley. Some went from Buffalo by boat to Erie, by stage from Erie to Beaver, and thence by steamboat to St. Louis and the Illinois river. In 1831, the fare from New York City to St. Louis by this route was $57.62.[4] Others left the Lake Erie boats at Ashtabula or Cleveland and went south to the Ohio river. Occasionally travelers left the Ohio river at Cincinnati and journeyed by stage to St. Louis.[5] The line of the Ohio, Mississippi, and Illinois rivers was often used by people intending to settle as far north as Bureau county[6]; in 1830 such settlers found steamboat service available to Peoria, but the remainder of the trip was by land, or canoe and keel boat. Some of the Bureau county settlers using this route sent their goods by ship to New Orleans. The difficult portion of the trip was considerably shortened when steamboats ran west regularly to Maumee Bay and Detroit. From the former point emigrants sometimes went up the Maumee river in keel boats, hauled their goods across the twelve or fifteen mile portage to the Wabash, and floated down the latter stream to the vicinity of Terre Haute, from which point they went west by wagon into Illinois.[7] Emigrants are known to have made their way from Detroit to Bureau county on foot.[8] The delays and difficulties encountered in reaching the Illinois valley as late as 1831 are strikingly illustrated by the experiences of the founders of Princeton. This place, like many of the early towns in New England, was founded as a colony by a religious society, and not by individuals as such. The Hampshire Colony was organized at Northampton, Massachusetts, in March, 1831. In May the members of the colony met at Albany for the trip west. They went by canal boat to Buffalo, and from there by steamer to Detroit. Unable to secure passage on a sailing vessel to Chicago, they

[1] Turner: Rise of the New West, pp. 80-82.
[2] Willard: Transactions Illinois Historical Society, 1906, p. 74.
[3] Jones: Illinois and the West, p. 254.
[4] Illinois Monthly Magazine, V. 2, p. 53.
[5] Flint: Railroads of the United States, p. 257.
[6] Bradsby: History of Bureau County, pp. 86, 129; Matson: Reminiscences of Bureau County, p. 253.
[7] Conkey: Transactions Illinois Historical Society, 1906, pp. 214-218.
[8] Matson: Reminiscences of Bureau County, p. 252.

hired teams and went overland to Mottsville, Michigan, on the St. Joseph river. From this point they proceeded down stream in canoes sixty-five miles to the great bend, where a five mile portage led to the Kankakee, down which they floated into the Illinois river.[1]

Navigation was late in developing upon Lake Michigan, and not until 1834 could emigrants count with certainty upon transportation to Chicago. In 1831 only three sailing vessels came to Chicago.[2] The first steamboat arrived in 1832.[3] From then on, the number of arriving vessels increased rapidly; in 1833 there were 4; in 1834, 176; in 1835, 250; in 1836, 456.[4] In 1840 there were forty-eight steamers on the upper lakes, and in 1841 six of the largest boats were regularly employed in running from Buffalo to Chicago.[5] By 1848 there were 400 vessels, including over sixty-four steamers, navigating the lakes.[6] With the multiplication and improvement of boats, the length and cost of the trip to Illinois were greatly reduced.[7] In 1840 the distance from Chicago to Buffalo had been covered in two days and two nights.[8] Cabin fare on the better boats from Buffalo to Chicago fell from about $25.00 in 1838,[9] to $6.00 to $8.00 in 1852.[10] Steerage fare was considerably less. It was now possible, furthermore, to take household goods, farming implements, and stock into the west easily and cheaply.

Numbers of northern immigrants.—A flood of settlers now poured into the Illinois valley and the northern part of the State generally. In 1845 the steamboats alone carried 97,736 passengers from Buffalo to the west, of whom 20,244 were landed at Chicago.[11] They had been carrying nearly as many for several years. Many also went in sailing vessels. Buffalo had shipped to Illinois in 1843 nearly seven million pounds of merchandise, and over a million and a quarter pounds of furniture.[12] Chicago was the gateway to the Illinois valley. From a "little mushroom town"[13] in 1833, and a "dirty village of twenty hamlets"[14] in 1834, it grew to a population of 4,479 in 1840, and 28,269 in 1850.[15] The value of its imports rose 523 per cent in the ten years following 1836.[16] It is not easy to overestimate the importance of steam navigation on the Great Lakes in the settlement of the counties with which this report is especially concerned, and northern Illinois in general. A recent writer has declared that "the great pervading power which influenced the settlement of northern Illinois and built up this portion of

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[1] Matson: Reminiscences of Bureau County, pp. 261-262.
[2] Parker: Growth of Illinois and Chicago, p. 14.
[3] Albach: Annals of the West, p. 957; Blanchard: The Northwest and Chicago, p. 423.
[4] Niles' Weekly Register, V. 51, p. 274; Mitchell: Sketches of Illinois, p. 31; Blanchard: The Northwest and Chicago, p. 423.
[5] Albach: Annals of the West, p. 958.
[6] Hall: The West; Its Commerce and Navigation, p. 33.
[7] Ferris: The States and Territories of the Great West, p. 204.
[8] Pooley: University Wisconsin Bulletin, No. 220, p. 75.
[9] Jones: Illinois and the West, p. 254.
[10] Curtiss: Western Portraiture, p. 31.
[11] Albach: Annals of the West, pp. 958-959.
[12] Hall: The West; Its Commerce and Navigation, p. 35.
[13] Ferris: The States and Territories of the Great West, p. 212.
[14] Jones: Illinois and the West, pp. 236-237.
[15] De Bows' Review, V. 17, p. 262.
[16] Idem, V. 13, p. 198.

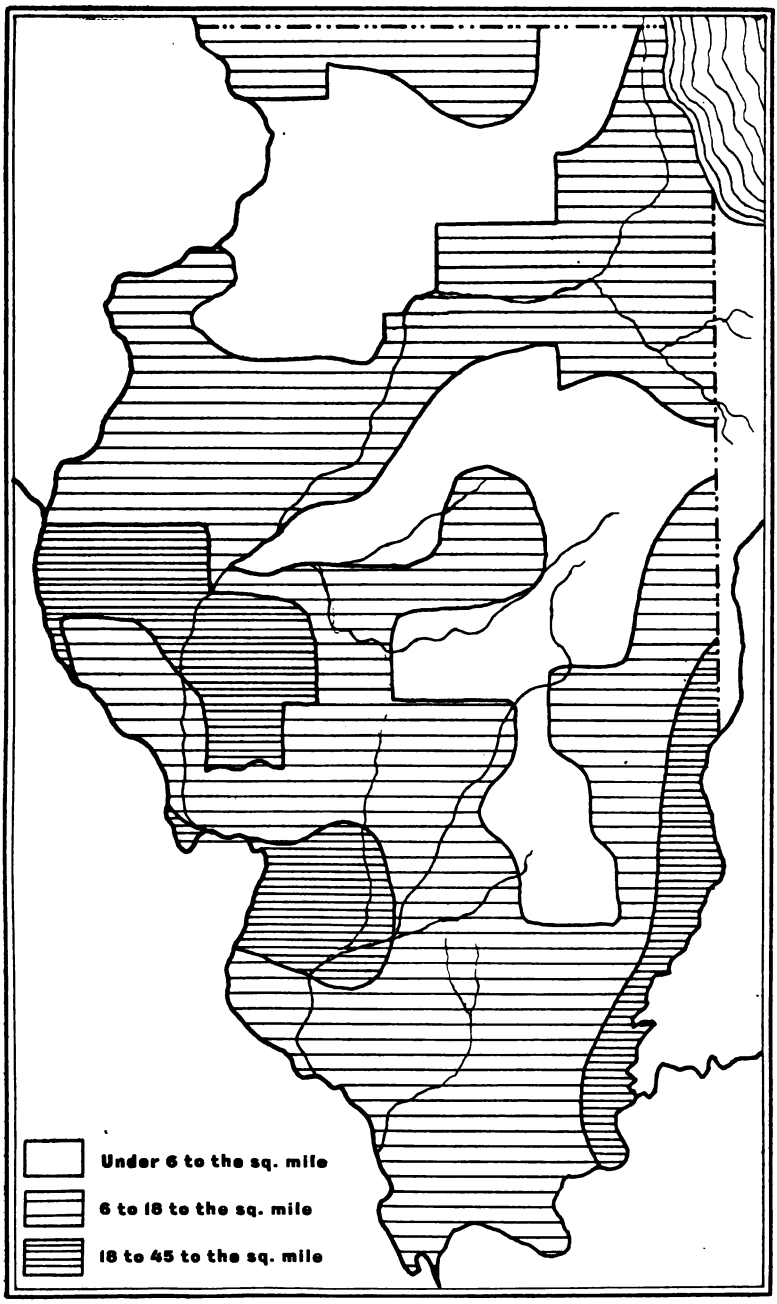

FIG. 36. Map showing distribution and density of population in Illinois in 1840.

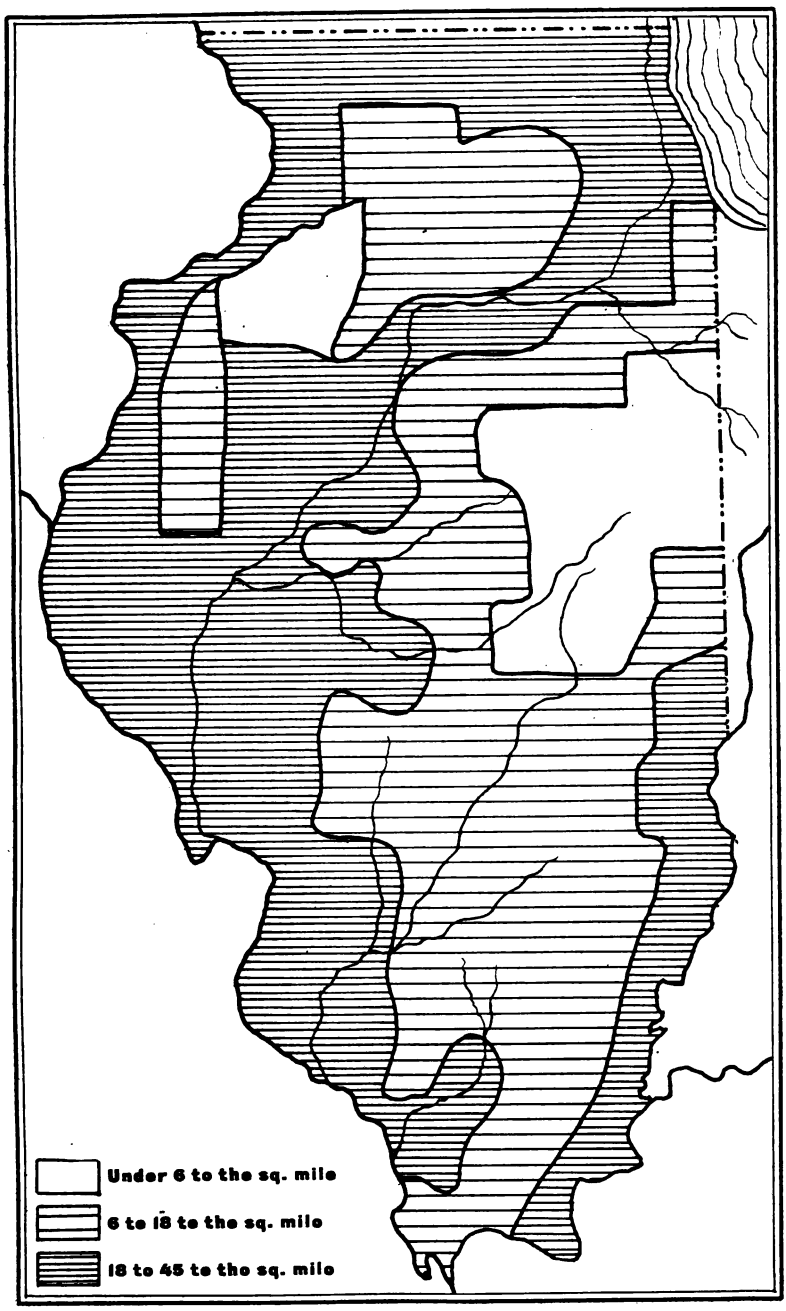

FIG. 37. Map showing distribution and density of population in Illinois in 1850.

the State with astonishing rapidity and which gave the northern character to its population, was the development of steam navigation upon the lakes."[1]

The influence of the Illinois valley upon the distribution of this northern population entering by way of the lakes is shown by Figure 36, which represents the distribution of population in Illinois in 1840. The population maps of 1850 and 1860 (Figs. 37 and 38) are equally instructive in this particular.[2]

Northern Pioneers Dominate the Region.

In the middle Illinois valley counties, from Tazewell and Peoria to Putnam and Bureau, the southern and northern waves of expansion already described met and mingled. This was due to geographic conditions. The southerner, arriving first, had followed the timber bordering the Illinois river far into the great prairie area. The northerner, following the Great Lakes, had been guided by the Chicago Outlet and the upper Illinois valley to the same region.

In Tazewell county the great majority of the early settlers were from the South. This was less strikingly true in Woodford county. In Marshall county the two elements were more nearly balanced, while in Putnam and Bureau the northerners overwhelmingly predominated. A rude stratification of the two types of settlers resulted from the fact that the timber was confined to the borders of the streams, while the inter-stream areas, save for occasional island-like groves, were prairies (Fig. 35). Tongues of southern influence extended north along the timber strips, while New Englanders and New Yorkers, upon solving the problem of the smaller prairies, pushed south between them. Delavan, in southern Tazewell county, was an interesting New England prairie colony of this type. Many of the northeastern immigrants settled in towns on coming to Illinois, and contributed to their rapid growth.[3] Thus Peoria, though all save one of the first permanent American settlers were southerners,[4] soon took on the characteristics of a New York or New England town. Of the 642 voters in Peoria in 1845, 402 were natives of states north of the Ohio and Potomac rivers, and 52 of states south of those rivers; only 2 were born in Illinois, and 2 west of the Mississippi river, while 184 were natives of Europe.[5] The character of the Illinois valley as a great highway of travel and migration is reflected in the fact that these voters represented twenty-one states and ten European countries. Five years later a writer said of Peoria, "the population of our city, as the western phrase is, 'is mightily mixed,' from forty-three states and kingdoms."[6] Half the states in the Union were represented in Woodford county.[7]

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[1] Pooley: University Wisconsin Bulletin, No. 220, p. 287.
[2] The maps of 1870 and 1880, plates 10 and 11, Statistical Atlas, Twelfth Census, show the continued influence of the Illinois valley upon the distribution of population.
[3] Moses: Illinois—Historical and Statistical, V. I., p. 386.
[4] Peoria was settled in April, 1819, by a party of seven Americans from Shoal Creek, Clinton County, Illinois. Of the founders, two were Kentuckians, two Virginians, and one from New York. Two went overland to Peoria with pack horses, the others in a keel boat up the Mississippi and Illinois rivers. Drown: Record and Historical View of Peoria, p. 81.
[5] Ballance: History of Peoria, pp. 201-202.
[6] Drown: Record and Historical View of Peoria, p. 115.
[7] History of Woodford County, p. 224.

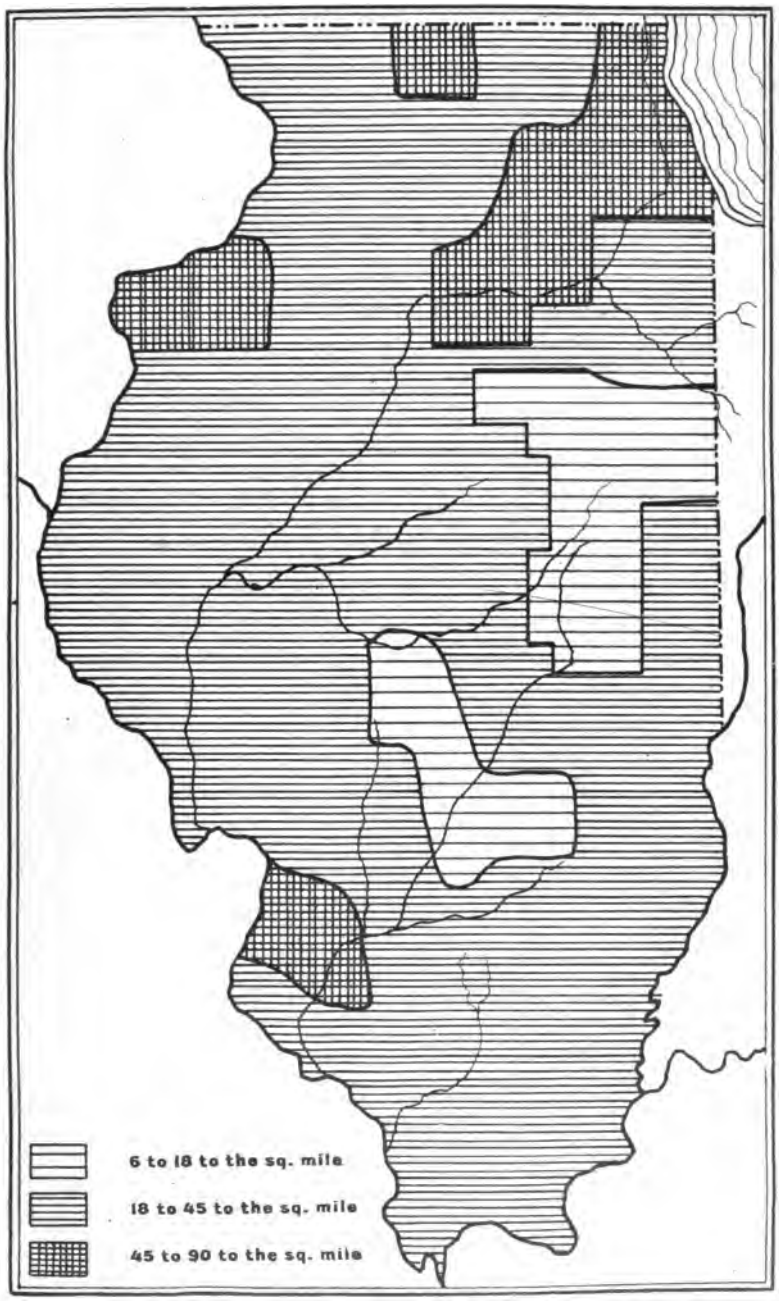

FIG. 38. Map showing distribution and density of population in Illinois in 1860.

The struggle between the northern and southern settlers for dominance in the middle Illinois valley was only a phase of a larger contest involving all middle and northern Illinois. Largely because of the development of navigation upon the lakes, numbers were on the side of the northerners. The New Englanders and New Yorkers, furthermore, were, as a rule, possessed of greater means, and characterized by greater energy, thrift, and ingenuity, traits induced in no small degree through generations by the geographic conditions of New England.[1] They accordingly presently impressed the stamp of northern institutions and ideals upon the debatable territory.

Distribution of Early Population.

The census maps (Figs. 33, 34, 36, 37, 38) give only a general idea of the distribution of population, since they are based on the county as a unit. Attention is now directed to the several factors which determined the immediate distribution of the early settlers.

Navigable streams.—One of the greatest problems facing the pioneer was the transportation of his produce to a market. For years there were few roads and these unimproved, so that the black soils of the upland prairie became a well nigh impassable sea of mud when saturated.[2] This was invariably the case in spring, when travelers might confidently "expect to be obliged to wade through mire and water—ankle deep, knee deep, and peradventure deeper than that."[3] The Illinois river was the only connection with the outside world until the appearance of the railroad, unless the journey were made by wagon to Chicago. In general, therefore, the earlier settlers located near the Illinois or one of its navigable tributaries. A number of its tributaries, now totally unfit for navigation, could be used by flat boats and canoes before the more or less complete removal of the timber which bordered them. This was true, for example, of Crow creek, opposite Chillicothe.[4]

Bottom lands and terraces.—While it was highly desirable to be within easy hauling distance of the Illinois river, settlers commonly avoided its heavily wooded and unhealthful flood-plain. Fever and ague were especially to be dreaded on the lower portions of the flood-plain near the bluffs,[5] and settlers who chose the bottom lands were advised to build their homes on the highest part of the natural levee, at the edge of the stream.[6] Here woodcutters occasionally established themselves, but

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[1] It was feared by some that the New Englander would lose these characteristics in the Illinois valley. A correspondent of the New York Observer wrote, in 1840, that "the two greatest objections to the west, in my judgment, are, that the land is too cheap and too productive. Taking human nature as it is, however industrious and virtuous emigrants from the scanty and rugged soils of New England may be, they must in general, without a miracle to prevent it, degenerate when planted down in the fat valleys of the Scioto, the Wabash, or the Illinois. It is a law of our lapsed natures, not to work if we can help it." Western Farmer, V. I., p. 147.

The character of the settlers was, indeed, somewhat modified by the new environment. "Even the quiet, conservative men from the East became rough, independent and simple in habits, careless of dress, frank in speech, friendly and generous to all whom they could trust." Pooley: University Wisconsin Bulletin, No. 220, p. 269.

[2] Bradsby: History of Bureau County, pp. 401-402.

[3] Illinois Monthly Magazine, V. 2, p. 49.

[4] Beck: Gazetteer of Illinois and Missouri, p. 103.

[5] Idem, p. 18; and Dana: Geographical Sketches on the Western Country, pp. 141-142.

[6] Peck: Guide for Emigrants, p. 179.

rarely, if ever, escaped the flood-plain diseases.[1] The bottoms of tributary valleys were often more desirable. Thus the combined invitation of fertile soil and navigable waterway led to the occupation of the lower Crow creek valley as early as 1830, and a considerable settlement soon developed.[2]

The terraces of the Illinois river were very much more desirable than the flood-plain, and were occupied early. For several years the population of Peoria county was largely confined to the Peoria and Chillicothe terraces.[3] The Henry terrace was one of the first parts of Marshall county settled.[4]

Woodland and prairie.—The prairies of northern Illinois aroused the wonder of all early travelers. They were attributed to fires; to hurricanes which had blown down the timber, leaving it to be readily consumed by fire when dry; to the former presence of lakes; and to other causes.[5] The upland prairies are now generally thought to have been due to the undrained condition of the flattish inter-stream areas, which practically prevented the growth of the species of trees adapted to the latitude. Occasional protracted droughts and fires, furthermore, doubtless served to kill any young trees that had succeeded in establishing themselves. Summer droughts were especially effective in killing seedlings on the sandy terraces of the Illinois valley, where they were probably a chief cause of the general absence of trees. Quite as much as any other factor, the distribution of woodland and prairie affected the settlement and early life of the region under discussion.

The prairies were generally shunned by the first comers for several reasons: (1) Absence of trees was thought to mean that they were infertile. (2) Timber was imperatively needed for buildings, fences, and fuel.[6] (3) They did not afford running water for stock or mills, while the lack of fuel left steam mills out of the question.[7] (4) There was no protection from the bitter winds of winter, which, above all else, made that season disagreeable.[8] Men and cattle had even been known to perish in storms on the open prairie.[9] (5) To the farmer, the prairies with their tough sod and matted roots constituted a new and altogether unknown problem.[10] Men were for a time helpless before this

[1] Flagg: The Far West, V. I., p. 98; Jones: Illinois and the West, p. 171.
[2] Ford: History of Putnam and Marshall Counties, p. 130.
[3] History of Peoria County, p. 285.
[4] Ford: History of Putnam and Marshall Counties, pp. 136-137.
[5] Peck: Guide for Emigrants, pp. 111-116.
[6] The great demand for timber in central and northern Illinois was amusingly illustrated in the middle thirties in the lower part of the peninsula between the Illinois and Mississippi rivers. This was a hilly, wooded district (FIG. 35) where lumbering was an important early industry. Lumbermen stole timber in large quantities from the lands of non-resident owners, to whom it had been given for services in the War of 1812. The latter brought suits for damage, but the witnesses and jurors being all on the other side, nothing was accomplished. Then ministers of the gospel were sent out to preach the sin of stealing timber. Each preacher had a regular circuit, and was paid by the sermon. It is said, however, that the non-resident owners succeeded no better in protecting their timber by the gospel than they had by law. Ford: History of Illinois, p. 171.
[7] History of Woodford County, p. 386.
[8] Peyton: Statistical View of Illinois, p. 11.
[9] Hoffman: A Winter in the Far West, V. 2, p. 55.
[10] Albach: Annals of the West, p. 993; Western Monthly Magazine, V. 5, p. 341; Matson: Reminiscences of Bureau County, pp. 397-398.

problem, and the prairies were generally regarded as "uninhabitable for an age." As late as 1836 the few who thought the prairies capable of occupation were regarded as crazy visionaries.[1]

The combined influence of streams and timber withheld large portions of the middle Illinois valley counties from settlement for many years, for prairie land predominated in Tazewell county,[2] about half of Peoria county was treeless,[3] and nine-tenths of Bureau county was originally without timber.[4] Figure 35 shows prairie land somewhat in excess of woodland in Putnam and Marshall counties, and greatly so in Woodford county.

A good idea of the general effect of the distribution of timber and prairie upon settlement (referred to in the case of the southern pioneers on page 66) may be obtained by comparing Figure 35 with Figures 34, 36, and 37. The influence of the Grand Prairie and of the great prairies north of the Illinois river is especially well shown on the population map for 1840, and is clearly evident ten years later. It will, of course, be understood that the settled area had been occupied not simply because of the timber, but also because of the streams, which, as already pointed out, constituted at first the only, and until after 1850, the best highways leading to the rest of the country.

Figure 39 shows the original distribution of woodland and prairie in Bureau county. In 1831 the settlers (sixteen families) were almost all in the edge of the Big Bureau timber.[5] Five years later the western tier of townships was without a single inhabitant, and the tier next east had only five families, all in Concord township. There was no one living in Wheatland or Westfield townships, while Walnut, Ohio, and Milo townships each contained one family.[6] The settlers still reared their log cabins almost entirely in the edge of the timber by the side of springs; large prairie tracts had not even been surveyed. Indeed, Ohio and Walnut townships, although among the most fertile in the county, were mostly vacant until after 1850.[7] The same distribution of early population obtained in the other counties of the middle valley and throughout the northern part of the State.[8] The Union Grove area near Florid, in Putnam county, was settled in 1829, and increased in population faster than any other part of the county.[9] Most of the earliest settlers to the east of Lacon occupied the edge of the woods of Sandy and Crow creeks and the Illinois bluffs, in preference to Round Prairie, which lay between.[10] Walnut Grove and the timbered portions of Spring Bay township, in Woodford county, were settled long before any one

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[1] In 1836 Alby Smith, living near Princeton, became a candidate for the legislature. He had made a farm on the prairie, although locations in the edge of the timber were still available, and had expressed the opinion that ultimately all the prairies would be cultivated and crossed by railroads. The people of the district decided that a man holding such wild, visionary ideas was not fit to represent them. He was accordingly dropped, and Thos. Atwater of Hennepin elected. Matson: Reminiscences, p. 399.
[2] Illinois in 1837, p. 106; Peck: Guide for Emigrants, p. 302.
[3] Peck, p. 95; History of Peoria County, p. 293.
[4] Matson: Reminiscences of Bureau County, p. 23.
[5] Idem, p. 269.
[6] Bradsby: History of Bureau County, p. 171.
[7] Matson: Reminiscences of Bureau County, p. 391; Bradsby: History of Bureau County, p. 179.
[8] Davidson and Stuvé: History of Illinois, p. 346.
[9] Ford: History of Putnam and Marshall Counties, p. 97.
[10] Idem, p. 127.

ventured out upon the prairie.[1] A partial exception to the control of the timber appears in the case of the Illinois terraces. As indicated above (p. 77) these were settled early, and yet all appear to have been prairies.[2] Timber could be obtained easily, however, from the adjacent flood-plain or bluffs, and the other advantages of the terraces

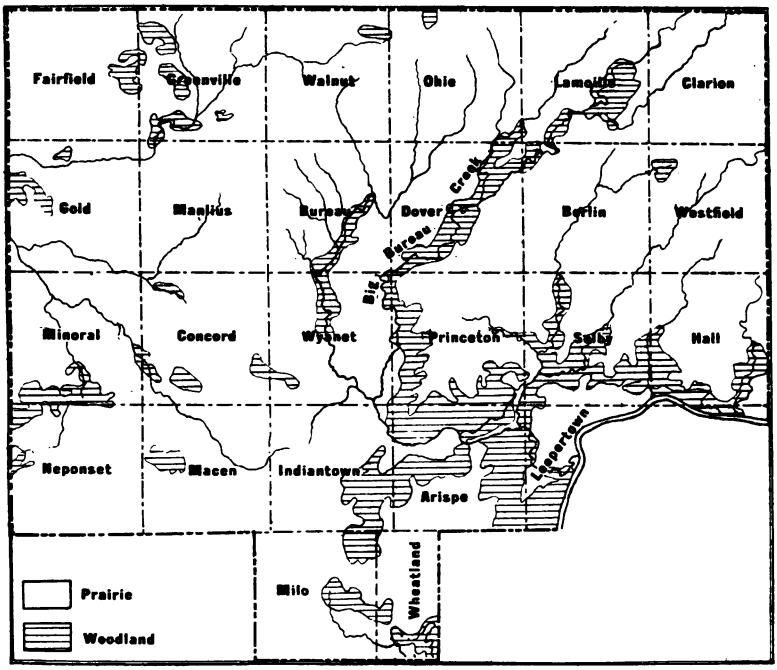

FIG. 39. Map showing original distribution of woodland and prairie in Bureau county. (Taxpayers and Voters of Bureau county.)

were marked. It is interesting to note that settlers were advised to build their homes on the south or southwest edge of the timber, because the summer winds were prevailingly from the southwest and west, while the timber afforded protection against the cold north winds of winter.[3]

THE CONQUEST OF THE SMALL PRAIRIES.

With the growth of population all the woodland was presently occupied, and new comers were crowded out upon the prairie. From the first, the enterprising New England farmer had used the timber as a base for the conquest of the prairie. He commonly built his cabin in the margin of the timber near a spring and enclosed some of the ad-

[1] History of Woodford County, p. 224.
[2] History of Peoria County, p. 285; Ford: History of Putnam and Marshall Counties, pp. 136-137 Ellsworth: Records of the Olden Time, p. 156.
[3] Peck: Guide for Emigrants, p. 179.

joining prairie land. This gave a supply of logs for building and fuel, allowed stock to take refuge from flies or storms in the woods, and permitted the planting of crops without waiting to clear the land. In consequence of this method of settlement, the small prairies were presently encircled with a belt of farms.[1] Later, another ring was established inside the first, and farther out on the prairie, and by a continuation of the process the entire prairie was finally occupied.[2] In the course of this process the pioneer learned how to break the prairie sod, and discovered the great fertility of its black clay loams. It was found easier to haul fuel and rails a few miles, than to clear forest land, and prairie farmers often purchased a small piece of land for timber in the nearest woods.[3] It was discovered that trees grew readily from seed on the prairie. Locally, coal became a cheap fuel.[4]

In general the smallest prairies having the best water supply, and bordered by the heaviest timber, were first occupied. Hoskins Prairie, near Bureau,[5] Ox Bow Prairie, east of Henry,[6] and Round Prairie, east of Lacon,[7] are notable examples. It is said that "in early days Ox Bow Prairie was as well known as Galena, Chicago, Peoria or any point in the State."[8] The larger prairies, away from the stream courses, remained in general unoccupied until after 1850, for although the settler had learned how to grow large crops upon them, he could not profitably transport the produce to a distant market. They were settled rapidly, however, upon the development of railroads in the decade 1850-1860 (p. 107).

Conditions of Pioneer Life.

Early privations.—Isolation subjected the earliest pioneers of the valley to many privations, and reduced their household and personal effects to the absolute necessities of life. The homes were rough log houses (Plate 16) with puncheon floors and clapboard doors; often there was not a nail or a particle of iron about them.[9] Indeed, many built their first cabins of saplings, with roofs of bark and clay chimneys. These homes usually contained no furniture save that which was hewn out with an axe. Homespun garments were the rule. Wild game supplied meat, and many families went weeks at a time without bread. Corn was pounded on rude hominy blocks.[10]

Leading products.—Corn promptly became the staple crop.[11] It was easy to cultivate, and peculiarly fitted to the prairie soil, returning a large yield. The harvest was long, an important consideration on the

[1] Illinois in 1837, p. 14.
[2] Ferris: The States and Territories of the Great West, pp. 209-210.
[3] Hall: Statistics of the West (1836), p. 103.
[4] Beck: Gazetteer of Illinois and Missouri, p. 18; Illinois in 1837, p. 96; De Bows' Review, V. 19, p. 410
[5] Matson: Reminiscences of Bureau County, pp. 267-268.
[6] Ellsworth: Records of the Olden Time, pp. 246-247.
[7] Ford: History of Putnam and Marshall Counties, p. 127.
[8] Ellsworth: Records of the Olden Time, p. 246.
[9] Peck: Guide for Emigrants, p. 181.
[10] History of Woodford County, p. 301; Matson: Reminiscences of Bureau County, pp. 237-238.
[11] Beck: Gazetteer of Illinois and Missouri, p. 38; Peck: Guide for Emigrants, pp. 147, 151, 155.

Type of early home in Illinois valley.

frontier where labor was scarce. It was easily stored, easily prepared for food, and possessed extremely nourishing properties for animals and man. Wheat and other crops were grown to less extent.

The raising of swine and cattle became important at an early date. The hogs obtained their own food in the oak timber which lined the Illinois and some of its tributaries,[1] while much of this broken bluff land was soon thought to have a surface too rough and a soil too thin for successful cultivation.[2] Furthermore, it was soon seen that "it was much easier to have the extra produce in the form of flesh, which would walk to market, than to have it in grain which had to be hauled."[3] Stock was driven in considerable quantity to Chicago (especially from Bureau county) and to Galena, which was the supply depot for the important lead mining area in the northwestern corner of the State. As an auxiliary industry, cheese was extensively made along the Illinois river, and found ready sale in St. Louis.[4]

Fences.—The development of stock raising brought the necessity of fences as protection for crops, and for years this need constituted one of the more serious problems of the prairies. Rails were used near the timber and were usually laid straight rather than in the form of the Virginia "worm fence," thereby reducing greatly the number required.[5] The cost of rails rapidly increased with the distance from the woods, and they were generally abandoned in Bureau county by 1850.[6] Boards were sometimes hauled from Chicago, but this likewise involved much expense as well as time. About 1850 the difficulty was largely solved by the introduction of wire fencing and the osage orange hedge.[7]

Mills.—Saw mills and grist mills constituted a pressing need of the settlers, and were among the first improvements made. As already indicated, lumber hauled from Chicago was extremely expensive, and yet lumber was in great demand for flooring, doors, and other uses. It was also a great inconvenience and hardship to be forced to pound grain on a hominy block, or to grind it in hand mills. For a time the nearest flouring mill to Putnam county was on Salt creek in Sangamon county, eighty miles away.[8] The first flouring mill in Putnam county was established in 1828, near Florid.[9] In 1830 a flouring mill was built on Kickapoo creek, three miles west of Peoria, which did a thriving business for a time, but was undermined and carried away by the stream.[10] Seven years later a second mill was started on the same stream, the machinery having been brought by wagon from Albany, New York.[11] A saw mill was erected upon Kickapoo in 1835.[12] The first grist mill in Bureau

[1] Ellsworth: Records of the Olden Time, p. 223.
[2] Illinois in 1837, p. 20.
[3] Bradsby: History of Bureau County, p. 380.
[4] Peck: Guide for Emigrants, p. 170.
[5] Ferris: The States and Territories of the Great West, p. 209.
[6] Matson: Reminiscences of Bureau County, p. 400.
[7] Hunt's Merchants' Magazine, V. 32, p. 62; Peyton: Statistical View of Illinois, p. 17.
[8] Ellsworth: Records of the Olden Time, p. 176.
[9] Idem.
[10] Drown: Record and Historical View of Peoria, pp. 89-90; Ballance: History of Peoria, p. 17.
[11] History of Peoria County, p. 598.
[12] Idem.

county was built on East Bureau creek, in 1830; the machinery was largely of wood, and the mill stones were dressed from glacial bowlders taken from the neighboring bluffs.[1] The following year the first saw mill of the county was erected on Big Bureau creek.[2] Many other mills were later built on these and other streams, although even in some of the larger ones, there was an adequate water supply for only two-thirds of the year.[3] Altogether some forty-seven water mills (31 saw mills and 16 flouring mills) were erected on the creeks of Bureau county, thirty of them on Big Bureau creek.[4] The great number of mills established, in spite of the relatively insignificant water power available, reflects their importance in the early economic life of the region. Largely because of the scarcity of fuel, few steam mills were established in the Illinois valley in the early days. None had been built in 1831,[5] but one was built in Lacon in 1836,[6] and two started up in Peoria by 1837.[7]

Prices and markets.—Another very serious problem to the pioneer was getting his surplus produce to a market. At first there were no local markets, and steamboat navigation did not develop on the Illinois river until the thirties. The farmers were therefore forced to take their corn, wheat, hams, bacon, etc., on flat boats down the river to St. Louis, and often to New Orleans.[8] Those who got down the river early might get a fair price for their produce, but the late comer was likely to find the market overstocked, and have to dispose of his cargo for little or nothing. The return trip from New Orleans with merchandise against the swift current of the Mississippi was a slow and most laborious process, and the farmer often preferred to sell for cash and walk home. Similar unsatisfactory conditions prevailed for years throughout the country dependent upon the western rivers.[9] As population increased, farms were taken up farther and farther back from the Illinois, and roads were opened to the river,[10] where at favorable places store houses and landings were established, usually by men from the East. This marked the appearance of the local merchant and the beginning of the river towns. Money was scarce and payment for produce was usually made in goods.

Settlers in Bureau county, and even in Woodford county, began as early as 1838 to haul their grain to Chicago, bringing back the much needed lumber and salt.[11] Each season during the following decade many farmers from the vicinity of Princeton started across the prairie after harvest when the roads were best, with thirty-five or forty bushels of grain to a load on the ten day trip of over one hundred miles to the

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[1] Matson: Reminiscences of Bureau County, pp. 278-279.
[2] Idem, p. 280.
[3] Illinois in 1837, p. 95.
[4] Matson: Reminiscences of Bureau County, pp. 404-405.
[5] Peck: Guide for Emigrants, p. 194.
[6] Ford: History of Putnam and Marshall Counties, p. 107.
[7] Illinois in 1837, p. 95.
[8] Atlantic Monthly, May, 1861, p. 581.
[9] Flint: Recollections of the last Ten Years in the Mississippi Valley, p. 247; Walker: The Mississippi Valley, p. 250.
[10] The importance of the river in the development of the region is reflected in the fact that even today upon the uplands the east and west river roads are often better than those which run north and south
[11] Matson: Reminiscences of Bureau County, p. 400; Bradsby: History of Bureau County, p. 162; Bailey: Illinois State Gazetteer, p. 57; History of Woodford County, p. 396.

lake.[1] The wagon trade with the interior was an important factor in the early growth of Chicago. In a single day in 1836 one hundred twenty-seven wagons were counted in its streets, loaded with merchandise for the country.[2] The first shipment of grain (78 bushels) was made from Chicago in 1838. In 1839, 3,672 bushels were shipped; in 1840, 10,000 bushels; in 1841, 40,000 bushels; in 1842, 586,907 bushels; and in 1847, when Chicago was still connected with the interior only by wagon roads, 2,243,201 bushels.[3]

The distance of the middle Illinois valley from large markets both to the west and the east, together with the cost of land transportation, meant high prices for merchandise and low prices for produce. Wheat often brought only 25 to 37½ cents a bushel, and sometimes less, when delivered at Chicago.[4] Nevertheless, produce appears to have been generally higher and merchandise lower in Chicago than at St. Louis. This was probably due to the superior connection of Chicago with the East by way of the Great Lakes and the Erie canal, as against the eastern connections of St. Louis through Pittsburg or New Orleans by rivers whose navigation was uncertain. These differences undoubtedly influenced the development of the Chicago wagon trade. The farmer trading with Chicago did not actually realize the prices indicated, however, for he had to subtract the expense of the long trip to the lake and the value of the time of team and driver. For the most part, the counties under discussion continued to be dependent on the Illinois river and St. Louis, until the opening of the Illinois and Michigan canal in 1848. The difficulty of transporting products to a satisfactory market was general in Illinois, and had created a strong demand for internal improvements.[5]

River Towns and Trade.

Physiographic conditions determine town sites.—The rise of the river towns and the development of steamboat navigation went hand in hand. Both the nature of the first demand for river towns and the conditions which determined the location of the more important ones, have been briefly referred to in preceding pages. A landing, a warehouse for grain, a general store, a blacksmith shop, one or all of them, were established at points convenient to the back country and accessible from the river. This simple beginning became the center of a cluster of houses and the nucleus of a town. Every important river town in the area is situated upon the edge of a terrace against which the river swings, and every such terrace has a town. It will be remembered that the presence of the stream on the terrace side of its flood-plain is in every case brought about by the deposits of a considerable tributary opposite, the size of

[1] The route from Princeton naturally led straight across the prairie to Chicago, diagonally across sections of land. As the intervening area settled up, however, the land holders fenced the road out, increasing its length. The Bureau county people interested in the Chicago wagon trade regarded as serious any increase in the already long trip, and petitioned the legislature for a straight road. The petition met w th approval, and the Princeton and Chicago state road was legalized. Matson: Reminiscences of Bureau County, p. 346; Bradsby: History of Bureau County, p. 162.

[2] Mitchell: Sketches of Illinois, p. 31.

[3] De Bow's Review, Second Series, V. 4, p. 115.

[4] History of Woodford County, p. 396; Bradsby: History of Bureau County, p. 162.

[5] Niles' Register, Sept. 12, 1835; De Bow's Review, V. 19, pp. 681-682; Walker: The Mississippi Valley, p. 258.

this tributary, in turn, being partly due to the fact that there was no terrace on its side of the valley. Such terrace sites were high enough to be healthful and safe from floods, but not so high as to make loading and unloading from boats difficult.

Short lived river towns.—At least two river towns were founded within the area of the report, whose sites are now vacant. Webster was founded in 1836 some two miles north of Henry. By the autumn of 1837 it contained a population of over one hundred, and boasted both a saw mill and grist mill, in addition to a grocery and a blacksmith shop. In 1838, the location proved to be very unhealthful, and the inhabitants began to leave. The town was entirely abandoned by 1842, and the houses were gradually removed or destroyed.[1] West Hennepin was laid out in 1836 on the Illinois bottoms opposite Hennepin. For a few years it carried on a considerable river trade in pork and grain, but being subject to inundation it soon ceased to grow, and was destroyed by the decline of river commerce and by the railroads.[2]

River towns precede inland towns.—With very few exceptions the inland towns of the area were founded later and grew less rapidly than the river towns. This was because the former, until the advent of the railroads, afforded no market. As late as 1850 the aggregate population of the inland towns of the six counties was less than 3,000, only 31 per cent of that of the towns located on the river.[3] More than a dozen of the present inland towns were not listed in the census returns.

Early history of Peoria.—The value of the site of Peoria was evident to the Indians. The roomy terrace at the lower end of a lake abounding in fish, the springs, the narrows in the river, where it was easily crossed, and the fertility of the surrounding land, appear to have formed an attractive combination. At different times important villages were established here and in the neighborhood by Indians whose presence is recorded by the name of the present city, by the names of Kickapoo and Black Partridge creeks, and of other geographic features in the vicinity. Indian trails focused upon the river at this point, among them the warpath which ran from the Wabash to the Des Moines river.[4]

Peoria was visited by Marquette in 1673, and six years later La Salle built Fort Crevè Coeur on the opposite bluffs. A French settlement was established as early as 1725,[5] and to the end of the French period it constituted a connecting link between their establishments on the Great Lakes and the Mississippi river. The French traders at Peoria did a driving business with the Indians in deer, beaver, otter, and mink skins,[6] so that the place was said to be the most important trading point in the Mississippi valley.[7] The French village was destroyed by an American

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[1] Ford: History of Putnam and Marshall Counties, pp. 121-123.

[2] Bradsby: History of Bureau County, p. 437; Ford: History of Putnam and Marshall Counties, p. 89.

A Frenchman named Beuro built a trading house on the west bank of the river prior to 1790. Each spring for some years he sent canoes loaded with furs and buffalo skins down-river to the lower markets. Bureau county takes its name from him. Matson: Reminiscences of Bureau County, p. 276.

[3] Compendium of the Seventh Census, p. 336 et seq.

[4] Drown: Record and Historical View of Peoria, p. 125.

[5] Bateman and Selby: Historical Encyclopedia of Illinois, p. 418.

[6] Ballance: History of Peoria, p. 210.

[7] Bateman and Selby: Historical Encyclopedia of Illinois, p. 418.

force during the War of 1812, because it was supposed that the inhabitants were in league with certain troublesome Indian tribes of the region. At that time the population, estimated at between 200 and 300, was composed of French traders, hunters, and voyageurs, together with a considerable number of half breeds and Indians.[1] The next year Fort Clark was built upon the site of Peoria, and in 1819 the permanent American settlement began, the first settlers, as already noted (f. n., p. 74), coming from the Shoal creek settlement, some forty miles east of St. Louis.[2]

Peoria was credited with the best town site and harbor in the entire west,[3] and in consequence of these advantages and the fertility of the surrounding country, it was predicted as early as 1823 that it would become a city of the first importance.[4] Nevertheless, the town grew very slowly during the first years. The American Fur Company, whose traders had passed from Lake Michigan to the Illinois river as early as 1778,[5] established a trading post at Peoria in 1824,[6] but the fur bearing animals of the region were nearing extinction. Fishing in the lake afforded some little basis for trade,[7] but as late as 1832 flour for food and corn for planting had to be brought from St. Louis.[8] In 1833 it was still a village of only about twenty-five families,[9] most of whom lived in log cabins.[10] The following year it began to grow rapidly,[11] and by 1837 it was said to have a population of about fifteen hundred.[12]

Advent of steamboat and development of river towns.—The development of steamboat navigation on the Illinois river was one of the most important events in the history of the valley. It created new towns and formed the basis of their growth; it stimulated the growth of its agricultural population; and it greatly increased the products and the prosperity of the region.

The first steamboat upon the western rivers was built at Pittsburg in 1811, but seventeen years passed before the first one appeared on the Illinois.[13] Till then the limited trade of the Illinois river was carried on in canoes, pirogues, flat and keel-boats.[14] The first steamboats on the river ran up only to Beardstown, founded in 1829 about ninety miles above the mouth of the stream, at the point which was, for a time, the head of navigation for the larger New Orleans steamboats.[15] Beardstown enjoyed a large trade. In 1831 steamboats arrived from St. Louis almost daily, and it was estimated that more passengers and goods were landed there than at any other point on the river. So recently and rapidly had it become important, however, that it was scarcely known south of St. Louis, and a consignment of goods from the East marked "Beards-

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[1] Bateman and Selby: Historical Encyclopedia of Illinois, p. 418; and Edwards: History of Illinois, pp. 65-66.
[2] Drown: Record and Historical View of Peoria, pp. 75, 81; Ballance: History of Peoria, p. 47.
[3] Edwards: History of Illinois, p. 66.
[4] Beck: Gazetteer of Illinois and Missouri, p. 147.
[5] Magazine of Western History, V. 12, p. 506.
[6] Bateman and Selby: Historical Encyclopedia of Illinois, p. 419.
[7] Beck: Gazetteer of Illinois and Missouri, p. 119.
[8] Ballance: History of Peoria, p. 211.
[9] Peck: Gazetteer of Illinois, p. 270.
[10] Hunt's Merchants' Magazine, V. 41, p. 688.
[11] Hoffman: A Winter in the Far West, V. 2, p. 57; Tanner: View of the Mississippi Valley, p. 228.
[12] Illinois in 1837, p. 138; Peck: Gazetteer of Illinois, p. 270.
[13] Mitchell: Sketches of Illinois, p. 14; Illinois in 1837, p. 34.
[14] Davidson and Stuvé: History of Illinois, p. 348; History of Peoria County, p. 526.
[15] Illinois in 1837, p. 115.

town, Ill.," remained for some time at Shawneetown on the Ohio river, where it had been landed by mistake, because the inhabitants of that place did not know where Beardstown was.[1]

The first steamboat to reach Peoria arrived in December, 1829. Another came in the following spring. In 1833 three different steamboats were running there; in 1834, seven; and by 1840, forty-four.[2] The great bend of the river at Hennepin was reached by the first steamboat that went above Peoria, in May, 1831, and by a second in the following September.[3]

There was no occasion for the first steamboat which reached Peoria to go beyond that point, for not a town existed on the river above. During the next seven years De Pue (then called Trenton), Hennepin, Henry, Lacon, and Chillicothe were all founded.[4] They depended almost exclusively upon the river trade in grain and meat, and substantial growth in most cases came only when steamboats became common above Peoria in the forties. Business depression following the panic of 1837 also retarded their growth.

The first building upon the site of Hennepin, a store, was erected in 1831, the goods having been bought in St. Louis, brought to Pekin by boat, and hauled from there by land.[5] In the 40's[6] and 50's[7] Hennepin had a large river trade in grain. An early attempt to draw trade from the west side of the river by establishing a ferry was stoutly opposed by the merchants of Princeton. Finally the people in southeastern Bureau county demanded an outlet by the river, and the ferry, together with an embankment leading to it across the flood-plain, was provided.[8] Important commercial cities frequently develop at conspicuous bends in navigable rivers, for at such points much traffic is likely to change from water transportation to land carriage, and vice versa. The early commercial importance of Cincinnati and Nashville was due, in no small degree, to their location at great bends of the Ohio and Cumberland rivers. In view of this, it might, at first thought, be supposed that its location at the great turn in the Illinois river should have given Hennepin a more rapid growth than it experienced. It is clear, however, that in general only up-river traffic, seeking points to the northward, and down-river traffic, seeking points to the westward of the bend of the Illinois, would leave the river there, and that the area to the northwest of the turn that would find its nearest river point at the bend, would be much larger than that to the southeast. In a word, towns of this type normally develop, as in the case of Cincinnati and Nashville, on the outside, and not the inside of the bend in the river. In the case of the Illinois, however, the inviting terrace was on the inside and here Hennepin was founded, while the land adjacent to the

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[1] Illinois Monthly Magazine, V. 2, pp. 100-101.
[2] Drown: Record and Historical View of Peoria, p. 107; Peck: Guide for Emigrants, p. 322.
[3] Bradsby: History of Bureau County, p. 116; Matson: Reminiscences of Bureau County, p. 284.
[4] Bureau is not properly a river town, but was created by the business of the railroad junction. Commenced in 1853, it was regularly laid out some time later. (Bradsby: History of Bureau County, p. 437.)
[5] Ellsworth: Records of the Olden Time, p. 161; Ford: History of Putnam and Marshall Counties, p. 87.
[6] Ford: History of Putnam and Marshall Counties, p. 89.
[7] Hawes: Illinois State Gazetteer, pp. 106-107.
[8] Ellsworth: Records of the Olden Time, p. 164; Matson: Reminiscences of Bureau County, p. 266.

river upon the outside was low flood-plain subject to annual overflow. The disadvantages in the location of Hennepin may have influenced the founding of West Hennepin (p. 84), though this is mere conjecture.

The site of Henry was chosen and a ferry license obtained by 1831.[1] A heavy business was carried on in grain after 1844,[2] and to invite trade from the east side of the river a bridge and a dike through the bottom lands were built.[3] Henry may have benefited at times by the fact that it was considered the head of low water navigation from St. Louis.[4]

Lacon was laid out in 1831,[5] many of its early settlers coming from Ohio.[6] The village promptly became an outlet for the surrounding grain producing country, and as early as 1837 was described as a "thriving little town."[7] It advanced most rapidly after 1850,[8] and promised to become, after Peoria, one of the most important points on the river.[9]

Rome, founded in 1832 and regularly visited by steamboats in 1835, never recovered from the effects of the panic of 1837.[10]

De Pue (Trenton) was the fifth river town established north of Peoria. In 1835 a large warehouse was built on the edge of a low terrace on the north shore of Lake De Pue. The following year two other storehouses were erected, and the place at once became the shipping point for a large area to the west of the river. As in the cases of the preceding towns, the grain was sent to St. Louis until the opening of the Illinois and Michigan canal in 1848.[11]

Chillicothe was laid out at the head of the upper Lake Peoria in 1836, some time after the first building was erected on the site.[12] It had a fine steamboat landing, and became a typical grain shipping town.[13] The need of an outlet for the farmers living on the east side of the river between Chillicothe and Peoria led to the founding of Spring Bay in 1838. For twenty years after 1844, Spring Bay was one of the most important grain markets on the river, and a hundred wagons were often seen on its streets in a single day.[14]

To the south of Peoria, Pekin dates from 1828, the name indicating the future greatness which is founders felt the advantages of its situation insured.[15] The place was injured by a visitation of cholera in 1834, but most of Tazewell county was commercially dependent on it, and it therefore developed a very large river trade.

Each one of the above river towns constituted a gateway between an agricultural community and the outside world, and its early importance

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[1] Ford: History of Putnam and Marshall Counties, p. 111.
[2] Idem, p. 113.
[3] Idem, p. 115.
[4] Hawes: Illinois State Gazetteer, p. 107.
[5] Ford: History of Putnam and Marshall Counties, p. 105.
[6] Idem, p. 106.
[7] Illinois in 1837, p. 99; Peck: Gazetteer of Illinois, p. 236.
[8] Ford: History of Putnam and Marshall Counties, pp. 109-110.
[9] Hawes: Illinois State Gazetteer (1858-9), p. 123.
[10] History of Peoria County, p. 582.
[11] Taxpayers and Voters of Bureau County, p. 159; Bradsby: History of Bureau County, p. 435.
[12] History of Peoria County, p. 577.
[13] Idem, p. 578; Hawes: Illinois State Gazetteer (1858-9), p. 61.
[14] History of Woodford County, pp. 305-306.
[15] Bailey: Illinois State Gazetteer (1864-5), p. 500.

highway of the Illinois river, and various important land routes. Its importance as a collecting and distributing center increased rapidly. In 1848 it had over eighty business establishments,[1] which represented an increase of over 100 per cent in three years.[2] Two years later its exports were valued at over one and a quarter million dollars.[3]

In 1822, a mail route was opened from Edwardsville (north-east of St. Louis) through Springfield to Peoria.[4] The northward extension of this road from Peoria to Galena became one of the great thoroughfares of the West. A rush of miners and prospectors to the Galena lead region began in 1822, when the mines were first effectively worked.[5] The output of ore reached nearly thirteen million pounds in 1828,[6] and by 1830 the population was between 900 and 1,000, nine-tenths of which were men engaged in mining.[7] In addition many went back and forth between the mines and the southern settlements each season.

This rapidly increasing mining population demanded food supplies in large quantities, and Galena became an important market for the Illinois valley, especially for Peoria and the farmers north along the line of the road in Bureau county.[8] The pioneer in the Galena trade was a man named Kellogg, who took three wagons and a drove of cattle across the prairies to Galena early in 1827.[9] His route soon became a beaten track, which for years was known as Kellogg's Trail. Meats constituted an important item in the trade, and because of the distance of the market and the difficulty of transportation, cattle and swine were driven in large droves to Galena and slaughtered there.[10] St. Louis was the great market for the Galena lead, which was taken down the Mississippi by boat; but much of the return travel and part of the return traffic was through Peoria and by Kellogg's Trail. This was a more direct route in consequence of the great western bend of the Mississippi along the boundary of Illinois, and avoided the slow up-river trip against the current. In 1831, the Galena stage left St. Louis once a week.[11] Stages left Peoria for Galena three times a week in 1837, and shortly there were daily stages each way.[12] Without doubt, Peoria derived much benefit from the Galena trade, especially down to 1845, when the mining industry culminated.[13]

The other routes extending from Peoria (Fig. 40) probably had less effect in the upbuilding of the town. That in some cases their business was not unimportant, however, is shown by the fact that as early as 1837 stages left three times a week for Chicago and for Springfield, and once a week for Knoxville.[14]

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[1] Western Journal, V. I., p. 114.
[2] Idem, p. 113.
[3] Drown: Record and Historical View of Peoria, p. 144.
[4] Davidson and Stuvé: History of Illinois, p. 352.
[5] De Bow's Review, V. 19, pp. 408-409.
[6] Niles' Register, August 29, 1829.
[7] Idem, V. 63, p. 388; Davidson and Stuvé: History of Illinois, p. 346.
[8] Bradsby: History of Bureau County, pp. 175-176.
[9] Matson: Reminiscences of Bureau County, pp. 291-292.
[10] Idem; Bradsby: History of Bureau County, p. 176; Illinois in 1837, p. 96.
[11] Illinois Monthly Magazine, V. 2, p. 54.
[12] Illinois in 1837, p. 126; Bradsby: History of Bureau County, p. 271.
[13] Illinois Blue Book, 1900, p. 141.
[14] Illinois in 1837, p. 126.

(5) Certain minor factors aided in the growth of Peoria. The fishing business in the lake, which was coeval with the settlement of the place, continued to be of some importance.[1] The sending of ice down-river to St Louis and other towns seems to have been a profitable business.[2] Peoria also had a considerable trade in coal. The first shipment by river appears to have been in 1821, when a boat load was sent down the Mississippi to St. Louis.[3] By 1850 some twenty thousand tons were being exported each year.[4]

(6) Because of its superior importance, many steamboats from St. Louis did not run above Peoria. This helped to make Peoria a distributing point for the towns to the northward, for freight on such boats consigned to up-river towns had to break bulk there.

While certain manufactures had started up in Peoria before 1850, still its growth to that time was primarily due to its commerce. After 1850 the rapid development of its manufacturing interests and its railroad connections became large factors in its progress, and made more absolute its leadership in the valley. These matters are considered later.

The period of the Illinois river steamboat.—The years 1835 to 1855 may appropriately be taken as marking the period of the supremacy of the steamboat on the Illinois river. Before 1835 there were few boats on the river.[5] After that the number increased rapidly. In 1836, thirty-five different steamboats passed Beardstown.[6] It will be remembered that the beginning of the period coincides essentially with the beginning of the substantial growth of Peoria (p. 85), and in a general way with the founding of several of the up-river towns. The exact date for the closing of the period is more or less arbitrary, but the importance of the steamboat trade on the Illinois river promptly declined, both relatively and absolutely, with the appearance of the railroad in the valley.

The development of the steamboat business on the Illinois is registered roughly by the number of steamboats running to Peoria. In 1833 there were three and in 1834 only seven. In 1840, however, forty-four different boats ran to Peoria; in 1841, sixty; and in 1844, 150. There were 694 arrivals of steamboats in 1845; 871 in 1846[7]; about 866 in 1847; 1,166 in 1848[8]; and 1,286 in 1850.[9] In addition to these, there was a large number of canal boats,[10] barges and flat boats. In 1852 there were about 1,800 arrivals of boats at Peoria.[11] The Illinois seems to have compared very favorably in commercial importance with the other great western rivers, judging from the number of steamboat arrivals from different points at St. Louis, which, because of its position near the mouths of the Missouri, Illinois, and Ohio rivers, and at the

[1] Hunt's Merchants' Magazine, V. 41, p. 687; Beck: Gazetteer of Illinois and Missouri, p. 119.
[2] History of Peoria County, pp. 528, 544-545.
[3] Ballance: History of Peoria, p. 174.
[4] Drown: Record and Historical View of Peoria, p. 144.
[5] Gould: History of River Navigation, p. 521; Drown: Record and Historical View of Peoria, p. 107.
[6] Illinois in 1837, p. 34; Mitchell: Sketches of Illinois, p. 14.
[7] Western Journal, V. 1, p. 113.
Idem, V. 2, p. 267.
[9] Drown: Record and Historical View of Peoria, p. 107.
[10] The Illinois-Michigan canal was opened in 1848.
[11] Western Journal and Civilian, N. S., V. 3, p. 349.

point where bulk was broken between the lighter draft boats of the upper Mississippi and those of heavier draft operating on the lower Mississippi, had become the greatest steamboat center on the western waters, with the exception of New Orleans.[1] The following table[2] shows the steamboat arrivals at St. Louis for four typical years:

	1847	1848	1849	1850
From the Illinois river	658	690	686	788[3]
From the upper Mississippi	717	697	806	635
From the Missouri river	314	327	353	390
From the Ohio river	430	429	401	493
From New Orleans	502	426	313	303
From Cairo	146	194	122	75
From other points	202	396	217	215

It will be noted that the Illinois river led in 1850, in spite of the fact that produce from the middle valley was moving through the Illinois-Michigan canal to eastern markets.

Until the opening of the Illinois-Michigan canal all the exports of the middle Illinois valley save those sent overland to Chicago and Galena, went down the Illinois river. The trade of the valley was an important factor in the growth of St. Louis. It has been seen that St. Louis was a great point of departure for settlers going into the Illinois valley.[4] In 1835 merchants could purchase exchange to any amount on the East only in St. Louis, and there they bought all their goods. St. Louis merchants were connected as owners or agents, with all the Illinois river steamboats. These boats required up-river as well as down-river cargoes, and the former could be obtained only in St. Louis.[5] Such close commercial connections continued until 1848.[6]

The Illinois and Michigan Canal.

A new and powerful factor in the economic life of the Illinois valley appeared in 1848 in the form of the Illinois and Michigan canal, to which reference has already been made. The canal opened new markets, brought the valley into closer relations with Chicago and the Great Lakes, and modified its life in important ways. The people of the middle valley had before faced for the most part toward the west; from now on they found their closest relations in the east. The salient factors in the history of the canal are next considered, insofar as they affected the area under consideration.

Physiographic processes make canal feasible.—Had the degradational work of the Chicago Outlet (p. 47) continued, the Great Lakes would have discharged permanently to the southwest, and the early economic history of the middle Illinois valley would doubtless have differed notably from that sketched above. As it was, the waterway to

[1] De Bow's Review, V. I, p. 147.
[2] Western Journal, V. 5, p. 258.
[3] Of these, 634 were from Peoria; Drown: Record and Historical View of Peoria, p. 145.
[4] Illinois Monthly Magazine, V. 2, p. 54.
[5] Ford: History of Illinois, pp. 176-177.
[6] Hall: The West; Its Commerce and Navigation, pp. 102,213.

the southwest was frequently continuous after heavy rains, so that boats of eight to ten tons burden carried freight between Lake Michigan and the Illinois river without portage.[1] The first produce sent from Peoria to Chicago, a small consignment of provisions for the use of the Fur Company (1825), was carried all the way in boats.[2]

Development of canal project.—A canal between Lake Michigan and the Illinois river was first suggested by Joliet, a member of the first white party (1673) that passed along the Chicago Outlet. Albert Gallatin declared in 1808 that there was no doubt of the practicability of opening a canal along this line.[3] Such a canal was considered a probability by a writer in Niles' Register in 1814, who predicted that it would make Illinois "the seat of an immense commerce."[4] It was agitated for two decades in Illinois before work was finally begun in 1836 with the aid of large land grants from the government.

Results expected from the canal.—It was expected that the influence of the canal would be far reaching and of the utmost importance. Its friends had urged that, among other things, it would open new markets by way of the Great Lakes, St. Lawrence river, and the Erie canal, that it would lower transportation rates, increase the prices of produce and lessen the cost of merchandise, increase greatly the population, products, and value of the adjacent land, decrease the danger of sectionalism by drawing closer together the Mississippi valley and the Great Lakes and East, and yield a revenue sufficient to pay the expenses of the State government.[5] Some of the anticipated results were realized, as shown below; others, notably the last, proved altogether extravagant.

Opening of the canal.—The Illinois and Michigan canal was planned and in part constructed as a ship canal, capable of accommodating the largest boats then navigating the Great Lakes. The lake level was to run out at the site of Lockport, where the first locks would be located. Here it was expected an important manufacturing and commercial city would develop, for which a name was selected (Lockport), indicating its advantageous situation with reference to both canal and lake.[6] The expense of making the projected deep cut through the Niagara limestone, however, and the heavy debts of the State, led to a modification of the plans. The canal had been given a depth of eighteen to twenty feet for some thirty miles; west of that, it was completed with a depth of only six feet. The canal is nearly one hundred miles long, with its western end at La Salle, the head of navigation upon the Illinois river.

The first boat to pass through the entire length of the canal from La Salle arrived at Chicago on April 23, 1848, with sugar from New Orleans.[7] The date (May 24,1848) of the arrival of the first canal

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[1] Beck: Gazetteer of Illinois and Missouri, p. 20; Publication No. 8 of the Historical Library of Illinois, p. 162; American State Papers, V. 20, p. 735.
[2] Drown: Record and Historical View of Peoria, p. 84.
[3] American State Papers, V. 20, p. 735.
[4] Niles' Weekly Register, V. 6, p. 394.
[5] Davidson and Stuvé: History of Illinois, p. 487; Hunt's Merchants' Magazine, V. 9, p. 97; Niles' Register, November 19, 1831; Illinois in 1837, p. 20; Beck: Gazetteer of Illinois and Missouri, pp. 27-35.
[6] Bailey: Illinois State Gazetteer, (1864-5), p. 47.
[7] Report of the Board of Trustees of the Illinois and Michigan Canal, 1848, p. 2. The Annual Reports of the Board of Canal Trustees were published until 1869 in the Reports to the General Assembly of Illinois. Thereafter the yearly reports of the Board of Canal Commissioners for Illinois to the Governor were published in separate form. These reports constitute the most satisfactory history of the canal.

boat from Lake Michigan was "a day of rejoicing and triumph" in Peoria.[1] During the remainder of the year 496 canal boats visited the city.[2]

Early traffic on the canal.—Lumber was the most important article brought into the Illinois valley through the canal. It has already been commented upon as one of the greatest needs of the prairies (p. 81). Their occupation led to the exploitation, beginning early in the thirties, of the great forests of Michigan and Wisconsin. Logs cut in the interior were floated down all the streams of Michigan, which flow toward the west. At the mouths of these rivers busy towns developed where the logs were manufactured into lumber. St. Joseph built what is said to have been the earliest steam mill in western Michigan in 1832, and Muskegon built one in 1837, while Grand Haven, Manistee, and other points also became important lumber centers. The manufactured lumber was transported across Lake Michigan at low rates to Illinois.[3] By 1839, mills had started up on the shores of Green Bay, Wisconsin, which soon began to send their product south to the prairies.[4]

Practically all the lumber for the prairies passed through Chicago. The first shipment appears to have been received there in 1833,[5] but not until 1836 was there any active demand from the interior.[6] Until the opening of the canal, Chicago sent lumber into the interior only in wagons, by which it was sometimes carried two hundred miles or more.[7] In 1845 over twenty-two million feet of lumber in addition to quantities of shingles, lath, and fencing material were received at Chicago.[8] Because of the cost of wagon transportation, pine lumber from Chicago was scarce and very expensive in the middle Illinois valley. The alternative source of supply for pine was the forests of the Allegheny in western New York and Pennsylvania.[9] Lumber was brought from there to Peoria by way of the Ohio, Mississippi, and Illinois rivers.[10] In 1838, pine lumber sold in St. Louis at from $50.00 to $60.00 per M, and in Peoria at from $60.00 to $70.00; at inland points the cost of carting had to be added.[11] This price was prohibitive to the majority, who were compelled to use the less desirable timber growing in the valley. Even this sold at $25.00 to $35.00 per M,[12] and settlers at a distance from the streams sometimes built their homes of clay, roofing them with lumber. At about the same time medium quality pine sold for $12.00 to $14.00 in Chicago,[13] and before the opening of the canal it fell to $9.00 to $13.00.[14]

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[1] Drown: Record and Historical View of Peoria, p. 103.
[2] Western Journal, V. 2, p. 267; Hunt's Merchants' Magazine, V. 41, p. 688, reports the arrival on the same date at Peoria of a canal boat built at Rochester, N. Y., that had come by way of the Erie Canal, Lake Erie, the Ohio and Erie Canal, and the Ohio, Mississippi, and Illinois rivers. This illustrates the round-about routes by which Peoria communicated with the East before the opening of the Illinois and Michigan Canal.
[3] Industrial Chicago, V. 4, p. 318; V. 5, pp. 25, 40.
[4] Idem, V. 5, p. 31; Dana: The Great West, pp. 107-108.
[5] Industrial Chicago, V. 5 ,p. 20.
[6] Idem, p. 19.
[7] Idem, pp. 43-44.
[8] Idem, p. 32.
[9] Western Journal and Civilian, N. S., V. 3, pp. 22-23.
[10] Hunt's Merchants' Magazine, V. 41, p. 695; Drown: Record and Historical View of Peoria, p. 105.
[11] Jones: Illinois and the West, pp. 207-208.
[12] Idem.
[13] Industrial Chicago, V. 5, p. 32.
[14] Prairie Farmer, V. 6, p. 296; V. 7, p. 264.

Upon the opening of the canal great quantities of pine and cedar lumber were taken into the Illinois valley. The cost of lumber was immediately reduced one-half at Peoria, and further reductions soon followed.[1] There was at once a notable change in the character and number of buildings erected. In 1848, 125 buildings were put up at Peoria, and in 1849, 245.[2] The population of the city increased 67 per cent between 1847 and 1849.[3] The canal gave a tremendous impetus to the lumber trade of Chicago. The receipts in 1848 lacked only about 4,000,000 feet of being double those of the preceding year.[4] In 1857, they were over 459,000,000 feet, and in the decade 1848-1857 they amounted to more than 2,000,000,000 feet, in addition to enormous quantities of lath and shingles.[5] The lumber business was for years the most important enterprise of Chicago.[6] It was said that the receipts of 1856 required the services of a fleet equal to 166 first class brigs.[7] Chicago lumber merchants established yards at Peoria, Pekin, and other river towns,[8] and delivered lumber by canal boats as far west as Lexington, Missouri, and Ft. Leavenworth, Kansas.[9] The lumber trade of Chicago and the canal and river was injured to some extent by the exploitation of the pineries of the upper branches of the Mississippi. In the fifties lumbering was extensively carried on along the LaCrosse, Black, St. Croix, and other Mississippi tributaries. Each spring the product of the winter's work was floated down-stream to St. Louis and other markets.[10] Large quantities of this northern pine were later sawed in Illinois mills along the Mississippi, especially at Rock Island and Moline,[11] and in 1885 the canal commissioners complained of the "diversion of the lumber trade of the Illinois river."[12] Receipts of lumber in the Illinois valley by rail from Mississippi river points had grown so large as to seriously affect the business of the canal.[13]

Although a great number of different articles were brought from the East by canal to the middle Illinois valley, only agricultural implements, machinery, general merchandise, and salt, in addition to lumber, were of any great importance. Great quantities of salt were required in the meat industry of the river towns (p. 109). Between 1850 and 1865, 628,776 barrels of salt were transported on the canal.[14] The canal gave an important impetus to the salt industry of New York, Onondaga salt competing with Kansas salt as far west as St. Louis.[15]

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[1] Drown: Record and Historical View of Peoria, p. 105; Hunt's Merchants' Magazine, V. 41, p. 695.
[2] Drown: Record and Historical View of Peoria, p. 147.
[3] Idem, p. 148.
[4] 1847, 32, 118, 225 feet; 1848, 60, 009, 250 feet. Hunt's Merchants' Magazine, V. 40, p. 229.
[5] Idem. The year following the opening of the canal, Chicago's first railroad, the Galena & Chicago Union, was opened to the Des Plaines river, and the number and length of the railroads radiating from the city increased rapidly during the next few years (FIG. 44). In the long run the railroads were the most potent factor in the growth of the lumber trade of the city, but for some years the canal was much more important. Industrial Chicago, V. 5, p. 50.
[6] Industrial Chicago, V. 4, p. 318; Curtiss: Western Portraiture, pp. 45-46.
[7] Chicago Magazine, V. 1, p. 276.
[8] Industrial Chicago, V. 5, p. 44.
[9] Idem; Kingsford: Impressions of the West and South, pp. 20-21.
[10] Western Journal and Civilian, N. S., V. 3, pp. 22-23; Curtiss: Western Portraiture, p. 337.
[11] Porter: The West in 1880, p. 163.
[12] Annual Report of Canal Commissioners, 1885, p. 4.
[13] The canal transported less than twenty-five million feet of lumber in 1885, only about one-eighteenth of that carried in 1857; Idem, p. 29.
[14] Annual Report of Board of Trustees, 1865, pp. 50-51.
[15] Chicago Daily Democrat, February 23, 1849.

East bound traffic through the canal was of two general classes, (1) southern commodities seeking a northern and eastern market, and (2) surplus products from the lands bordering the canal and the nearer western rivers to which it led. The Illinois river and canal became at once an important trade route between the lower Mississippi and the Great Lakes and East, through which large quantities of sugar, molasses, hemp, and tobacco were shipped.[1] The prices of these articles were doubtless much lower than formerly along the Illinois river. In the second class of commodities corn,[2] pork, bacon, hams, and lard led.[3] Whiskey from the Peoria distilleries was also an important item. It had been expected that the opening of the canal would lead to a large development in coal mining along the Illinois valley, but although some coal was sent from the interior to Chicago, Pennsylvania coal, in consequence of its superior quality and cheap lake transportation, dominated the market. The following table[4] shows the leading items in the canal trade between 1850 and 1865, together with the amounts transported:

Corn, bushels	83,204,570
Oats, bushels	15,040,447
Wheat, bushels	8,728,161
Flour, barrels	829,228
Bacon, pounds	10,309,838
Pork, barrels	155,953
Whiskey and high wines, barrels	65,966
Lumber, feet	1,022,708,754
Shingles and lath, number	754,960,791
Merchandise, pounds	77,160,555
Iron and steel, pounds	8,888,186
Iron—pig and scrap, pounds	22,967,580
Stoves and hollow ware, pounds	11,222,387
Agricultural implements, pounds	7,749,252
Machinery, pounds	5,593,917
Sugar, pounds	45,907,586
Salt, barrels	628,776
Molasses, pounds	14,519,385
Coal, tons	192,975
Stone, cubic yards	955,779

The canal made travel to the Illinois valley less expensive and more agreeable. The trip between Chicago and Peru was four hours shorter than it had been by stage, and the fare upon the best boats was only four dollars including meals and berth. A slower line of freight and emigrant packets charged two to three dollars.[5] Three packets started daily from each end of the canal in 1849,[6] during which year the travel was equivalent to 26,446 passengers carried its entire length.[7] At Peru the traveller could secure steamboat transportation to St. Louis for from three to five dollars.[8]

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[1] Annual Report of Board of Trustees, 1865, pp. 50-51.

[2] The canal made Chicago the leading corn market as well as the leading market for lumber. In 1851 the lake ports that shipped east most heavily through the Erie canal and the quantities of corn they contributed were:

Chicago	2,351,888 bushels.
Toledo	1,828,502 bushels.
Cleveland	458,502 bushels.
Detroit	223,204 bushels.

Benton: Johns Hopkins University Studies, Series XXI, Nos. 1-2, p. 103.

[3] Annual Report of Board of Trustees, 1865, pp. 50-51.

[4] Idem.

[5] Curtiss: Western Portraiture, p. 62; Industrial Chicago, V. 4, p. 299.

[6] Chicago Daily Democrat, May 3, 1849.

[7] Report of Board of Trustees, 1849, p. 10.

[8] Curtiss: Western Portraiture, p. 76.

Influence of the canal upon the course of trade.—The opening of the Illinois and Michigan canal precipitated a struggle between Chicago and St. Louis for the trade of the Illinois valley and the West. It was generally anticipated that the great bulk of the produce of the valley would move eastward, and that Chicago would become the great depot for the Illinois river.[1] St. Louis was accordingly opposed to the canal project,[2] and even the merchants of New Orleans were alarmed.[3]

For some three years following the opening of the canal, St. Louis prices were in general higher than those at Chicago, and in consequence the greater part of the grain, meat, and flour of the Illinois valley went south; canal boats coming from Chicago with lumber, merchandise, and salt were at times unable to secure return cargoes along the Illinois river.[4] A similar situation occurred in 1856 because of a partial crop failure in some of the southern states.[5] This illustrates the tremendous advantage to the valley of the new order of things; there was now a choice of markets, and its produce could be sent wherever it would bring the largest returns. The course of trade during the years mentioned proved the exceptional rather than the normal thing. In general the results that had been anticipated were realized, and the trade of the Illinois river was reversed, Chicago becoming its great market.[6] The leading commercial journal of the West noted in 1852 that "as a grain market, St. Louis is becoming less and less important."[7] That year Chicago received nearly four times as much corn as St. Louis, practically all of it by the canal.[8]

It is not to be understood that the diversion of trade under discussion was brought about entirely by the Illinois and Michigan canal, nor that it was confined to Illinois. The canal began it, so far as middle Illinois was concerned, but it was continued on a vaster scale by the railroads that, in the fifties, were built west from Chicago. A similar change was in progress in adjacent states. The Wabash and Erie canal reversed the trade of the Wabash valley, and relieved Indiana of all economic dependence on the southwest.[9] The shipments to the north on the Ohio canals were greatly in excess of those to the south.[10] New Orleans was described in 1850 as a city which "once the emporium and mart of the immense empire of the west, sees her commercial rank and position fading away."[11] Ten years later the receipts of grain at Chicago were nearly ten times those at New Orleans.[12]

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[1] Western Journal, V. 6, pp. 167-168; Hoffman: A Winter in the Far West, V. 2, p. 59.
[2] Western Journal, V. 6, pp. 167-168; Chicago Daily Democrat, January 27, 1849.
[3] Idem, November 24, 1848.
[4] Annual Report of Board of Canal Trustees, 1848, pp. 155-156; 1850, pp. 8-9, 86; Western Journal, V. 6, pp. 167-168, 170.
[5] Chicago Magazine, V. I, p. 275.
[6] De Bow's Review, V. 15, p. 374; Curtiss: Western Portraiture, pp. 45, 47; Gould's Peoria Directory, 1880-1, p. 3.
[7] De Bow's Review, V. 14, p. 394.
[8] Chicago's receipts were 2,999,011 bushels (Peyton: Statistical View of Illinois, p. 39), and St. Louis' 755,258 bushels (Eighth Census, Agriculture, p. clvi).
[9] Benton: Johns Hopkins University Studies, Series XXI, Nos. 1-2, pp. 104-105.
[10] Eighth Census, Agriculture, p. clviii.
[11] Western Journal and Civilian, N. S., V. I., pp. 4-6, 113.
[12] Eighth Census, Agriculture, pp. clvii, clviii.

A number of considerations had enabled the Illinois and Michigan canal to reverse the trade of the Illinois valley, some of which explain in part the corresponding change in neighboring areas. (1) It was cheaper to ship grain in bulk by canal boats, than in sacks (the usual method) by steamboats.[1] (2) The facilities for receiving and forwarding grain at Chicago were superior to those at St. Louis. Chicago had twelve large grain warehouses by 1857 and charged lower storage and commission fees.[2] (3) It was said that grain could be shipped from a point on the Illinois river to Chicago as cheaply as to St. Louis, and that the charges from Chicago to New York were not greater than those from New Orleans to New York. This, if true, obviously gave Chicago the very considerable advantage of the freight charged between St. Louis and New Orleans.[3] In the middle fifties (1854), long distance freight rates on the Great Lakes were only about one-half as high as on the western rivers.[4] (4) Save in exceptional years the prices of farm products were higher and those of merchandise lower in Chicago than at the Mississippi river cities (p. 83). (5) There was danger in summer of the grain being heated and damaged in the warehouses of New Orleans, and during its passage through the Gulf of Mexico. (6) Transportation by the round-about southern route took much longer. (7) The superiority of New York over New Orleans as an importing point, due in large part to its relative nearness to Europe, and its unparalleled connections with the interior by way of the Hudson-Mohawk depression and the Great Lakes, made it also a more desirable exporting point, since the competing ocean lines offered lower freight rates.[5]

By making it the gateway of the Illinois valley, the Illinois and Michigan canal became a powerful factor in the growth of Chicago.[6] The imports of the city increased from about two and one-half millions in 1847 to over eight and one-quarter millions in 1848, the first year of the canal. The exports increased from a little over two and a quarter to nearly ten and three-quarters millions in the same time.[7] The canal helped Chicago to become, in the early fifties, the largest grain and lumber market in the world.[8] The population of the city rose from 16,859 in 1847[9] to 60,652 in 1853.[10]

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[1] Brown: Drainage Channel and Waterway, p. 205.
[2] Chicago Magazine, V. I, p. 275.
[3] De Bow's Review, V. 14, p. 394.
[4] Idem, V. 19, pp. 196-197; V. 20, pp. 80-81.
[5] Eighth Census, Agriculture, p. civii.
[6] Chicago Magazine, V. I, p. 389.
[7] De Bow's Review, V. 13, p. 198.
[8] Peyton: Statistical View of Illinois, p. 43.
[9] De Bow's Review, V. 13, p. 198.
[10] Peyton: Statistical View of Illinois, p. 36.

The development of a commercial city near the end of Lake Michigan that should serve as a point of contact between the manufacturing and commercial east, and the agricultural west, was inevitable. The harbor afforded by the Chicago river and the line of the old Chicago Outlet determined its exact location. Although the harbor was an indifferent one, it gained value from the very paucity of natural harbors along the Lake Michigan coast. The advantages of this situation were not generally recognized, however, until after the opening of the Illinois and Michigan canal. In 1823 Major Long declared that Chicago not only then offered no inducements to business men, but was likely at all times to have a limited trade. (Niles' Register, V. 57, p. 35.) A leading commercial writer, as late as 1843, thought that the commercial metropolis of the Great Lakes was to develop on Maumee Bay, Lake Erie, and that the most Chicago could reasonably hope for was second place. (J. W. Scott: Hunt's Merchants' Magazine, V. 9, p. 46.) The events resulting from the opening of the canal and the building of Chicago's first railroads, revealed the city in its true light, however, and led to the declaration in 1855 that Chicago "is destined to be not simply the first city in the Mississippi valley, but with probably three exceptions the first city on the continent." (Peyton: Statistical View of Illinois, p. 48.)

Influence of the River and Canal Upon Population and Products.

A comparison of the census returns for 1840 and 1850 brings out clearly the influence of the Illinois river and the canal upon the development of the counties with which this report is chiefly concerned. The population of these six river counties increased 154 per cent during the decade in question.[1] In the same time the population of the three inland counties bordering them on the east and southeast increased only 74 per cent,[2] and that of the four inland counties touching them on the north and northwest, 118 per cent.[3] The population of the State as a whole increased 78 per cent during these years. Not simply were the river counties growing faster than those on either hand, but within the former the townships near the great waterway were in general most densely settled and gaining most rapidly. While this statement may be made with confidence, the census reports permit anything like exact comparisons between townships only in Bureau county. There the six southeasternmost townships (See Fig. 39) contained about 38 per cent of the population of the county, in spite of the considerable areas withdrawn from occupation by flood-plain and bluff lands, while the remaining 62 per cent were scattered in nineteen townships.[4]

The influence of the waterway is shown in another way. In 1850 there were nearly 1,000 more farms in the six river counties than in the adjoining seven inland counties.[5] The average cash value of farm land in the river counties was $9.78 per acre; in the four inland counties to the northwest it was $8.69; and in the three to the southeast, $8.09.[6] 15.6 per cent of the area of the six river counties was improved land, but only 9.9 per cent of the inland counties.[7]

The differences noted between the river and inland counties disappeared in the next decade when the building of railroads led to the rapid settlement of the great interstream prairies.

The Decline of River and Canal Commerce.

Rate and extent of decline.—The year 1855 has been taken as marking the close of the period of steamboat supremacy in the trade of the Illinois valley (p. 91). The following years witnessed an extraordinary decline in river trade. By 1870 only four steamboats, a pitiful remnant of the great fleet of the late forties, ran regularly between St. Louis and Peoria, and but one of these four extended its trips to LaSalle.[8] Seven

[1] Illinois Blue Book, 1900, Tables, pp. 287-288.
[2] Idem.
[3] Idem.
[4] The census does not give the population of any of the six southeastern townships, but fortunately does give that of all the others with a single exception. The above comparison is only approximately correct, since it ignores the missing township and credits the six in the southeast with the difference between the total population of the county and that of the eighteen townships reported. (Seventh Census, pp. 703-704.)
[5] Compendium Seventh Census, Tables, pp. 220-229.
[6] Seventh Census, pp. 728-729.
[7] Idem.
[8] Ballance: History of Peoria, p. 159.

per cent only of the units of freight received at Peoria in 1875 came by the river.[1] Four years later Peoria received about forty thousand tons of freight by river; this was but a little over five per cent of the total amount received.[2] The next year (1880) only two steamboats made regular trips between Peoria and St. Louis.[3] A writer of the eighties thought it unlikely that water transportation would again be a necessity for years to come.[4]

A similar decrease occurred in the trade of the Illinois and Michigan canal. It was described within nine years of its completion (1857) as an "old fogy institution."[5] The tolls increased, however, with much variation from year to year, until the middle sixties, and its tonnage until the early eighties (Figs. 41 and 42); after that its business rapidly diminished and has now practically ceased.

Causes of decline of water trade.—This decline in water traffic was brought about primarily by the competition of the railroads and the shallowness, during many summers, of the Illinois river. Various other factors contributed to the triumph of the railroad, however, especially (1) the short season open to navigation; (2) the slowness of water transportation; (3) the lack of coöperation between river and canal service; (4) the limited capacity of the canal; (5) the losses involved in steamboat navigation; and finally (6) unreasonable wharfage charges, and over-competition in river trade. (1) The upper Mississippi and its tributaries were closed by ice four months or more each year.[6] The canal was open on the average only 237 days each year between 1848 and 1900.[7] This suspension of traffic was of course very disadvantageous; the railroads were able from the outset to monopolize business for a considerable fraction of the year. (2) The best steamboats on the Illinois river required twenty to thirty hours for the trip from Peru to St. Louis.[8] The canal boats depended upon animal towage which meant slow, tedious travel, and usually involved delays in the harbor at Chicago and at La-Salle, while waiting for steam vessels to tow them.[9] The canal accordingly lost its entire passenger business when the Chicago, Rock Island, and Pacific Railroad opened parallel to it in 1853. The preceding year travel on the canal had been equivalent to 25,966 passengers through its entire length.[10] The middle Illinois river also lost much of its passenger trade following the opening of the railroad from Peoria to Bureau in 1854 (Fig. 44). Furthermore, the superior speed of the railroad secured it the transportation of all perishable and highly manufactured articles. The waterway could only hope to compete in the movement of heavy, bulky, and non-perishable commodities. (3) Through business on

[1] Sixth Annual Report of Trade and Commerce of Peoria, pp. 52-53.
[2] Gould's Peoria Directory, 1880-1, p. 4.
[3] History of Peoria County, p. 528.
[4] Gould: History of River Navigation, p. 745.
[5] Chicago Magazine, V. I, p. 389.
[6] Hall: The West: Its Commerce and Navigation, pp. 96-97.
[7] Annual Report Canal Commissioners, 1902, p. 31.
[8] Curtiss: Western Portraiture, p. 76; Ellet: Summer Rambles in the West, pp. 234-235.
[9] As late as 1876 only twenty-two steam canal boats were in use. Annual Report Canal Commissioners, 1876, pp. 5-6.
[10] Annual Report of Board of Canal Trustees, 1853, p. 9.

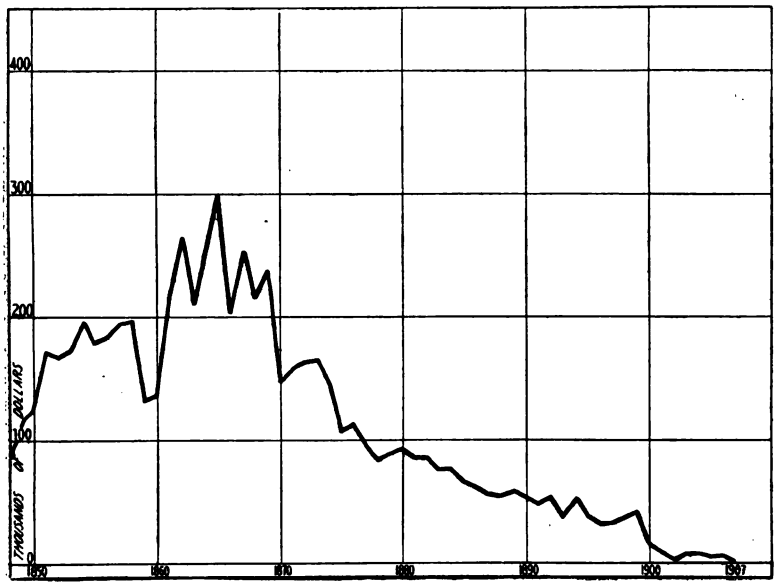

FIG. 41. Graph showing tolls collected by Illinois and Michigan canal from 1848 to 1907

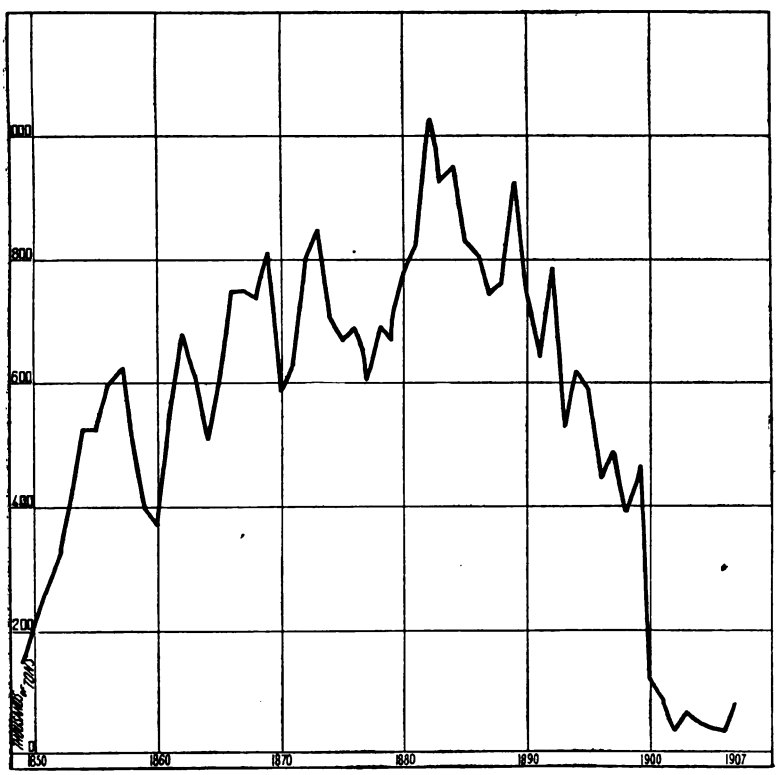

FIG. 42. Graph showing tons transported on Illinois and Michigan canal from 1849 to 1907.

the waterway was inhibited for the want of a line of steamboats on the river running in connection with the packets on the canal. Boats plying between St. Louis and Peru had no regular days of starting. The need of remedying this defect was promptly pointed out,[1] but a number of years appear to have elapsed before it was accomplished. (4) The canal could not accommodate boats of more than four feet eight inches draft, carrying a maximum load of about one hundred fifty tons. Even this was not possible when the water supply was deficient. (5) Losses were heavy in steamboat navigation from boilers bursting, machinery breaking, and from other causes. Boats were destroyed not infrequently, and the usual insurance rate on steamboats was from ten to twelve per cent per annum.[2] (6) The facility with which boats could be built was said to have led to over-competition in the river trade, and wharfage extortions and discriminations were complained of at times.[3] It is difficult to judge of the importance of these charges.

The canal officials repeatedly declared the greatest cause for the decline of water traffic to be the shallowness of the Illinois river. It will be remembered that the Illinois is an aggrading river that is attempting, through deposition, to form a channel suited to the small volume of water which it has had since it ceased to be the outlet of Lake Chicago. Bars formed,[4] especially off the mouths of tributaries, upon which at times there was not more than twenty inches of water. This was the case, for example, from the middle of June until November in 1856 when, in consequence, navigation on the river was virtually suspended for nearly six months.[5] The lowest water appears to have been reported in 1867, when there was only sixteen to eighteen inches on many of the bars.[6] Again steamboats could ascend to Peoria or Henry, but were prevented by low water from going further.[7] At such times traffic on the navigable portion of the river was forced to move to the south.[8] Such difficulties from low water, furthermore, were of frequent occurrence. The river was almost closed to steamboats in 1841[9] and in 1845.[10] The officials of the canal complained of loss of business because of low water in 1851, 1852, 1853, 1854, 1856,[11] and frequently thereafter. On the other hand, the very satisfactory returns of the year 1865 in comparison to the immediately preceding years (Fig. 41), were attributed almost entirely to the unusually high water in the Illinois river throughout the season of navigation.[12] In 1854 the canal commissioners wrote: "It is not the competition by railroad that the canal has to fear; it is the want at times of sufficient water in the Illinois river. With that avenue available for boats drawing four feet of water for the eight or nine months

[1] Chicago Daily Democrat, November 24, 1848.
[2] Gould: History of River Navigation, pp. 581, 584.
[3] Idem.
[4] Annual Report Canal Commissioners, 1876, pp. 13-14; 1890, p. 35.
[5] Annual Report of Board of Canal Trustees, 1856, p. 83.
[6] Idem, 1867, p. 51.
[7] Flagg: The Far West, V. I, p. 110; Annual Report of Board of Canal Trustees, 1852, pp. 97, 167-168.
[8] Chicago Daily Democrat, December 4, 1848.
[9] Niles' Register, V. 62, p. 87.
[10] De Bow's Review, V. I, p. 148.
[11] Annual Report of Board of Canal Commissioners, 1851, pp. 11-12; 1852, pp. 97, 167-168; 1853, p. 8; 1854, p. 12; 1856, p. 83.
[12] Idem, 1865, p. 10.

of the year in which the canal is available, there would be nothing further that the friends of the canal would have to ask; but so long as the Illinois river remains in its present condition, unimproved, either by the State or the United States, so long will the canal lie idle comparatively one-half of its season of navigation."[1] Again in 1876 the canal commissioners declared that "the large through lumber and grain trade that formerly passed over this route has nearly all been diverted into other channels by reason of low water, and the formation of bars in the Illinois river during the past few years."[2]

Because of the economic disadvantages noted above, the river and canal were totally unable to meet the competition of the railroads. In the discussion of the other causes for the decline of the once great waterway, it was seen that the railroad secured not simply the passenger trade

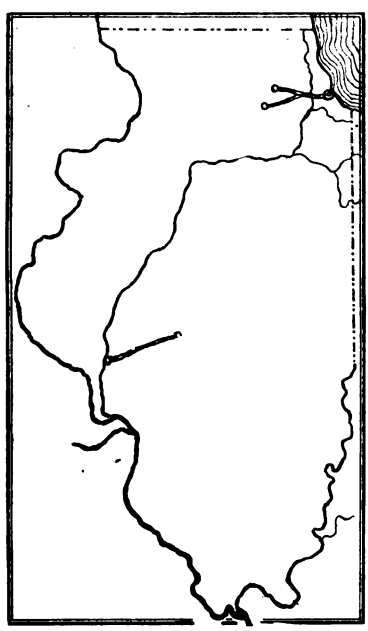

FIG. 43. Map showing railroads of Illinois in 1850.

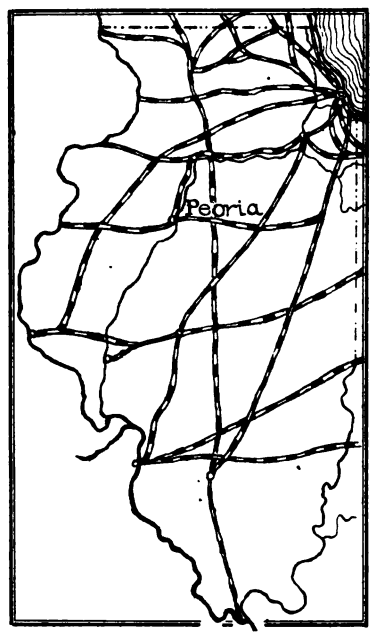

FIG. 44. Map showing railroads of Illinois in 1860.

and the traffic in perishable and highly manufactured articles, which passed to it logically, but finally also the trade in lumber and grain, which because of their weight and bulk and its lower rates, the water course might have been expected to retain. In a word, the history of the later transportation lines upon the Illinois river is a record of the

[1] Annual Report Canal Commissioners, 1854, p. 11.
[2] Idem, 1876, pp. 13-14.
Impressed with its very gentle current (a consequence of the low grade developed by the Outlet river) and with the general absence of the snags so characteristic of the Mississippi and Missouri rivers, earlier writers described the Illinois as the easiest river to navigate in the country, especially in going up-stream. Thwaites: Early Western Travels, V. 9, p. 190; Western Monthly Magazine, V. 5, p. 336; Publication No. 8 of the Historical Library of Illinois, p. 164; Peck: Guide for Emigrants, p. 330.

triumph of the locomotive over the steamboat. The famous "Five Day Line" of steamboats, organized in 1852 to run between St. Louis and LaSalle, did a thriving business until the railroad appeared, but a few years of railroad competition destroyed it.[1] The Illinois River Packet Company appeared in the field in 1858 and made a vigorous effort to meet the competition of the railroad, but failed and sold its boats to a new organization which, in about two years, was in turn forced to confess defeat.[2] The Naples Packet Line conducted a successful river trade for a longer time, but only because it was run in connection with the railroad extending from Springfield to the Illinois river at Naples (Fig. 43). This was for a time the only route from the Sangamon country to St. Louis except by stage, and was therefore very popular.[3]

The railroad was credited by some with the conquest of the Illinois and Michigan canal as early as 1857.[4] Reading the yearly reports of the canal officials, however, one is impressed with their conviction that the fundamental cause for the eclipse of the waterway was the unfavorable condition of the Illinois river, and that if the latter were improved, the canal might successfully compete for the transportation of certain classes of freight (pp. 102-103).[5] It is worthy of special note that physiographic processes were held chiefly responsible for the decline of one of the greatest commercial routes in the West.

Although their trade had departed, the river and canal continued to be of tremendous importance to the people of Illinois as regulators of railroad rates (p. 108).

The effect upon the river towns of the passing of the steamboat.— The Illinois river towns that obtained good railroad connections did not suffer greatly from the decline of river trade. This was especially true of Peoria, which became a great railroad center for the same reasons that it had before been an important road center (p. 89), and which also developed extensive manufacturing interests. It was true to less extent of Pekin. To every other river town within the area considered in the report, the passage of the steamboat was a serious blow, and several suffered an actual decrease in population.

De Pue had been the great shipping point for an extensive area west of the river (p. 87), and enjoyed a large trade until near the close of the fifties. By that time the back country had important railroad lines (Fig. 44), and the farmers ceased to haul grain to the river with its decreasing shipping facilities. The trade of DePue, except from the immediate vicinity, soon ceased, and in 1884 the place was described as a "queer little delapidated village," many of whose inhabitants depended on the lake for a living, fishing by summer and packing ice for one of the St. Louis breweries by winter.[6]

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[1] Gould: History of River Navigation, pp. 522-523.
[2] History of Peoria County, p. 527; Gould: History of River Navigation, pp. 523-524.
[3] Idem, pp. 521-522,523.
[4] Hunt's Merchants' Magazine, V. 37, p. 376; Chicago Magazine, V. I, p. 389.
[5] Typical discussions of the matter may be found in the Annual Reports of the Board of Canal Trustees for 1853, pp. 8, 9; 1854, pp. 11-12, 65-66; 1867, p. 7; 1868, pp. 98-99.
[6] Bradsby: History of Bureau County, p. 436; The Taxpayers and Voters of Bureau County, p. 159.

Hennepin (p. 86) experienced a decline similar to that of DePue. It had a population of 711 in 1857, and a large commerce,[1] but having lost its river trade and being without any railroad, each census since 1860 has recorded a decrease in population, that of 1900 being only 523.[2]

The population statistics of Henry tell of a period of rapid growth under the influence of river trade, and of one of relative stagnation following the passing of the steamboat. The substantial growth of the place began in 1844 (p. 87) with the multiplication of steamboats above Peoria. It contained 400 people in 1850.[3] During the next six years the population increased over four fold, reaching 1,664 in 1856.[4] Since the loss of its river trade, the town has been essentially at a standstill, having in 1900 only 1,637 inhabitants.[5] The story is again repeated, in principle, in the case of Lacon. In the late fifties this place had nearly 2,000 inhabitants,[6] but it was nearly stationary between 1860 and 1870, and since the latter date it has steadily lost.[7] Lacon's railroad service is far less satisfactory than that of Henry, since it is situated at the end of a branch line.

The decay of Spring Bay (p. 87) is particularly striking. In its best days, it is said to have had eight or nine grain warehouses to which practically all the farmers of Woodford county hauled their grain. In the spring eight or nine steamboats might be seen at the levee at a single time loading for the down-river market. The disappearance of the steamboats and the opening of railroads to the east of Spring Bay, running parallel to the river, proved a death blow to the town. Most of the inhabitants moved away, and the last warehouse was destroyed years ago.[8] Chillicothe (p. 87) has had a happier history. Like the other river towns mentioned, it suffered from the loss of its river grain trade, but it was fortunate in later becoming a junction point between two important railroads. Its population accordingly increased rapidly between 1880 and 1890, but it has been nearly stationary since.[9]

Attempts to Improve the Navigation of the Illinois River.

The improvement of the navigation of the Illinois river was urged for many years. Governor Ford caused the first survey of the river to be made in 1835, with a view to its improvement.[10] Steamboat owners advocated in 1848 the improvement of the channel by a system of

[1] Ford: History of Putnam and Marshall Counties, p. 89.
[2] Twelfth Census, Population, V. 1, p. 444. In 1860 the population was 1132 (Eighth Census, Population, p. 99); in 1880, 623 (Tenth Census, Population, p. 141); 1890, 574 (Twelfth Census, V. I, p. 129).
[3] Seventh Census, p. cxv.
[4] Hawes: Illinois State Gazetteer (1858-9), p. 107.
[5] Twelfth Census, Population, V. I, p. 444. The population in 1860 was 1800 (Ford: History of Putnam and Marshall Counties, p. 114); in 1870, 2162 (Ninth Census, Population, p. 116); 1880, 1728 (Tenth Census, Population, p. 139); 1890, 1512 (Twelfth Census, V. I, p. 126).
[6] Hawes: Illinois State Gazetteer (1858-9), p. 123.
[7] Population 1870, 2105 (Ninth Census, Population, p. 116); 1880, 1814 (Tenth Census, Population, p. 139); 1890, 1649 and 1900, 1601 (Twelfth Census, V. I, p. 126).
[8] Population 1860, 515 (Eighth Census, Population, p. 101); 1900, 128 (Twelfth Census, V. I, p. 133).
[9] Population 1880, 936 (Tenth Census, Population, p. 140); 1890, 1632 and 1900, 1699 (Twelfth Census, V. I, p. 128).
[10] Brown: Drainage Channel and Waterway, p. 260.

dredging,[1] and in 1852 the federal government made its first appropriation for that purpose.[2] The experiences of the year 1853, however, were said to have first forced the general public to recognize the disagreeable fact that the river required human aid.[3] The trustees of the canal yearly urged river improvements, declaring that unless they were undertaken the canal must continue of secondary importance, both as a producer of revenue for the State and as a channel for trade, and that if they were made, a steady increase from year to year in the business of the canal might confidently be expected.[4] During the Civil War the improvement of navigation between Lake Michigan and the Mississippi river was urged as a military measure. A bill introduced with this object early in 1862 failed after having been before the House for nearly a year, through the votes of Ohio and Indiana, whose representatives claimed that its military features were altogether subordinate, and that it was really an attempt to benefit a single state commercially at the expense of the whole country.[5] The attitude of Ohio and Indiana probably had a geographic basis, since from their locations these states were rivals of Illinois for the control of commerce passing between the Great Lakes and the western rivers. In his message of January 5, 1863, Governor Yates recommended that the General Assembly memorialize Congress in relation to the projected improvement, and maintained that it should be undertaken as a military necessity, as an aid to commercial, manufacturing, and agricultural interests, and because it would serve as a bond of union between the different sections of the country.[6]

Aside from dredging to overcome bars, the first improvement of importance was the Henry lock and dam, built by the State. A committee of the State Legislature had recommended a system of locks and dams as early as 1848,[7] but the improvement at Henry was not definitely provided for until 1867.[8] The lock was first used in January, 1872. The river business of that year was disappointing, nevertheless, the supposed cause being the unusually low water in the Illinois, and four more locks and dams between Henry and the mouth of the river were urged.[9] Another lock and dam was later built by the state and federal governments at Copperas creek, and two others by the latter farther down the river. Experience appears to have shown clearly that the dams and locks have injured rather than aided the navigation of the river. They constitute obstructions to the flow of the stream and, by checking its already slow current, cause further deposition and further choking of the channel.[10] The dams have probably also tended to increase the number and duration of floods, thus helping to prevent the agricultural use of the bottom lands.

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[1] Chicago Daily Democrat, December 4, 1848.
[2] Brown: Drainage Channel and Waterway, p. 260.
[3] Davidson and Stuvé: History of Illinois, p. 487.
[4] Characteristic statements occur in the Annual Report of the Board of Canal Trustees, 1855, p. 10; 1857, p. 9; 1866, p. 111.
[5] Brown: Drainage Channel and Waterway, pp. 231-232.
[6] Reports of the General Assembly of Illinois, 1863, V. 2, pp. 348-349.
[7] Brown: Drainage Channel and Waterway, pp. 260-261.
[8] Idem, p. 266.
[9] Annual Report of Canal Commissioners, 1872, pp. 29, 31, 33.
[10] Seventeenth Annual Report, U. S. Geological Survey, V. 2, pp. 744-745.

The federal government had appropriated over two million dollars for the Illinois river by 1900[1] for surveys, dredging, locks and dams. This is but a small fraction of the sum now demanded for the river (p. 122).

As a result of pronounced agitation for better sanitation in Chicago, the State Legislature authorized a slight enlargement of the Illinois and Michigan canal in 1865. The improvement was completed in 1871,[2] but proved of little value commercially.

The Railroads and the Settlement of the Great Prairies.

The great prairies still remained largely unoccupied in 1850, as a comparison of the woodland and prairie map (Fig. 35) with the population map for 1850 (Fig. 37) clearly shows. The problems of transportation and of markets still prevented their occupation. During the decade 1850 to 1860, however, their conquest was rapidly accomplished, and in the latter year (Fig. 38) the Grand Prairie had everywhere a population of over six to the square mile, and the great prairies to the north of the Illinois river more than eighteen per square mile. The population of the State as a whole increased over 100 per cent in the ten years.[3] This extraordinary change was made possible by the rapid building of railroads. In 1850 Illinois had only 110 miles of railroad[4] (Fig. 43); in 1860 it had 2,867 miles[5] (Fig. 44). During the decade Illinois built more miles of railroad than any other State, and more than Michigan, Wisconsin, and Iowa combined.[6] The topography of the State made it possible to build railroads rapidly and easily;[7] in the northern and eastern parts especially, the railroads were not held to certain predetermined courses by relief, but could be built with equal ease in almost any direction across the flattish surface of the upland prairies.

The railroads supplied lumber to the home builder on the great prairies.[8] They brought the farmer much closer to a market,[9] increased greatly the value of land in the vicinity,[10] and permitted a rapid growth in agriculture products.[11] In 1850 Illinois was the fifth wheat State,

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[1] Raymond: Index to Reports of Chief of Engineers, U. S. Army, V. 1, pp. 512, 517.
[2] Brown: Drainage Channel and Waterway, pp. 249-252.
[3] 1850, 851, 470; 1860, 1, 711, 951 (Illinois Blue Book, 1905, p. 580).
[4] Parker: Growth of Illinois and Chicago, p. 13.
[5] Idem.
[6] Illinois Blue Book, 1903, p. 156.
[7] Tanner: Canals and Railroads of the U. S., p. 194.
[8] Walker: The Mississippi Valley, p. 260; Ferris: The States and Territories of the Great West, pp. 208-209.
[9] An interesting estimate of the influence of railroads upon the transportation problem appeared in De Bow's Review, V. 14, pp. 79-80. It was thought that on the average wagon road the cost of transportation was 15 cents per ton per mile, and wheat was assumed to be worth $1.50 a bushel and corn 75 cents. Thirty-three bushels of each were taken to equal a ton. In that case the cost of transporting a ton of wheat became equal to its value at 330 miles, corn at 170 miles. In other words, the grain would be worthless at the distances mentioned from market. Railroad transportation, it was estimated, cost only one-tenth as much as that by wagon. Railroads, therefore, extended the economic limit for the transportation of wheat and corn respectively to 3,300 and 1,700 miles. At Chicago, however, 60 cents a bushel for wheat and 26 cents for shelled corn was a good price in the years just preceding the appearance of the railroad (Prairie Farmer, V. 6, p. 296; V. 7, p. 264); often the price was much lower (p. 83). At these prices corn would be worthless by wagon transportation at 57 miles from the lake port and wheat at 132 miles, while railroads would extend the respective limits to 570 and 1,320 miles.
[10] Davidson and Stuvé: History of Illinois, p. 572; De Bow's Review, V. 14, p. 80.
[11] Eighth Census, Agriculture, pp. clxv, clxvii.

with 9,414,575 bushels; in 1860, it was first with 23,837,023 bushels;[1] it was the third corn State in 1850, with 57,646,984 bushels; it was an emphatic first in 1860, with 115,174,777 bushels.[2]

Except along the edges, little of the great prairie tracts in the middle valley counties was occupied in 1850.[3] In the decade 1850 to 1860, the aggregate population of the six counties increased 124 per cent.[4] The area of the improved land increased 213 per cent,[5] and the grain production 165 per cent in the same time.[6] The relative increase in population in the prairie townships back from the river was much greater, but cannot be stated exactly outside of Bureau county.[7] There the townships of Walnut and Ohio (Fig. 39), already described as largely unoccupied in 1850, gained respectively 1,025 per cent and 489 per cent.[8] The adjacent inland counties whose growth before 1850 had been retarded by their distance from the river (p. 99), filled rapidly. The four on the north and northwest increased 190 per cent during the decade, while the three to the southeast gained 224 per cent.[9]

At the same time that the railroads were opening up the great prairies, improved farming machinery was facilitating their agricultural development. Drills, mowing machines, reapers, threshing machines, and the like were coming into general use.

Influence of the Illinois River and the Canal on Railroad Rates.

The importance of the Illinois river and the canal did not end with the loss of their carrying trade. Indeed, their greatest service to date has perhaps been their influence in securing low railroad freight rates. The competing railroads are forced during the season of navigation to establish rates near enough to the water rates so that shippers will prefer land transportation. This has saved the people living along the line of the river and canal many millions of dollars.[10] The value of the canal and river as freight regulators may best be shown by a few specific illustrations from various years.

(1) Corn was shipped by water in 1870 from Henry to Chicago, 130 miles, for 5 cents per bushel, wheat at 6 cents. The rate on the Chicago, Rock Island, and Pacific Railroad during navigation was 7 16/100 cents per bushel for corn and 10 cents for wheat; during the winter season the rate was 9 96/100 cents for corn and 12 40/100 cents

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[1] Eighth Census, Agriculture, p. xxix.
[2] Idem, p. xlvii.
[3] Ford: History of Putnam and Marshall Counties, p. 129; Matson: Reminiscences of Bureau County, p. 391; Bradsby: History of Bureau County, p. 179; Flint: Railroads of the United States, p. 336.
[4] Illinois Blue Book, 1900, Tables, pp. 287-288.
[5] Compendium Seventh Census, Tables, pp. 220-223, 226-229; Eighth Census, Agriculture, Tables, pp. 30-37.
[6] Seventh Census, Tables, pp. 730-731; Eighth Census, Agriculture, Tables, pp. 30-37.
[7] The population of all the townships is given in the census returns for 1860 (Eighth Census, Population, pp. 88-101), but for few of them outside Bureau County in 1850.
[8] Walnut, 1850, 71; 1860, 799. Ohio, 1850, 183; 1860, 1078. (Seventh Census, pp. 703-704; Eighth Census, Population, pp. 88-89.)
[9] Illinois Blue Book, 1900, Tables, pp. 287-288.
[10] It was estimated that in 1899 the eighteen counties bordering the river and canal north of and including Tazewell were saved $1,500,000 by the waterway on the corn, wheat, and oat crops alone. (Annual Report Canal Commissioners, 1901, p. 48.)

for wheat. On the railroads not subject to water competition the rates were from 11 to 14½ cents per bushel for corn, and 15 to 18 cents for wheat for the same distance.[1]

(2) The competing railroads establish notably lower rates during the navigation season than in winter, when they are in the position of a monopoly. Thus in January, 1875, the railroad rate on flour from Peoria to New York was 90 cents a barrel. It fell by stages to 50 cents in August, but rose again to $1.00 in the following December. The corresponding variations in the rates on grain, meats, etc., were of similar magnitude.[2]

(3) The Chicago, Rock Island, and Pacific Railroad has charged 15 cents per hundred pounds for freight from Tiskilwa (a few miles west of Bureau and beyond the reach of water competition) to Chicago, 122 miles, when it charged only 8 cents from Henry to Chicago, 130 miles.[3]

(4) In 1901, the railroad freight rates to Chicago in northern Illinois were lowest along the Illinois river and the canal, and higher with increasing distance from the waterway regardless of the distance from Chicago.[4] Yet in this year the canal itself had virtually ceased to carry freight (Fig. 42).

The Development of Manufactures.

There are two more or less distinct periods in the development of manufactures in the area, the first characterized by small establishments at many places, the second marked by large establishments at a few favored places. In both periods the more important manufactures belong to two classes: (1) Commodities demanded in the region which it was expensive and at times impossible to bring from a distance, and (2) commodities for the making of which the surplus products of the region afforded the raw material and which could be transported to a market more economically in the manufactured than in the crude state.

EARLY INDUSTRIES.

Slaughtering and meat packing.—The important manufactures of the first period were flour, feed, and lumber, already referred to on page 81, and especially slaughtering and meat packing. The making of whiskey also became an important industry before 1850. The raising of swine received attention early in the Illinois valley (p. 81). The business was peculiarly suited to frontier conditions. Much wooded bluff and ravine land was fit for little else. Corn, the leading crop, was bulky and heavy, and therefore difficult to transport to the distant markets. It was accordingly found advantageous to use corn in fattening swine, which could walk to market or, when killed, found a market at

[1] Annual Report Canal Commissioners, 1870, p. 39.
[2] Sixth Annual Report of the Trade and Commerce of Peoria, p. 33.
[3] House Executive Documents, 50th Congress, First Session, V. 5, p. 2145.
[4] Railroad Rate Map, opp. p. 28 of Annual Report Canal Commissioners, 1901.

the down-river cities, particularly New Orleans. At first all the slaughtering was done by farmers in the winter, who, after supplying their own wants, sent the surplus down the Illinois. Nearly 140,000 pounds of pork and 10,000 pounds of lard were shipped by river from Peoria county in February, 1835.[1] Later the industry was established in the towns. It was begun at Peoria in 1837,[2] and soon all the river towns participated actively. The few inland towns do not appear to have engaged to any extent in the business, owing to difficulties of transportation.[3] Slaughtering was still done by farmers who sold their surplus meat to the dealers in the towns, by whom it was cured for the market. The packing season was limited to the winter months.[4] The importance of the industry along the Illinois in comparison to other places is suggested by the fact that as many hogs were killed at Lacon in the season of 1849-1850, as at Chicago; Peoria killed nearly twice as many, and Pekin more than double the number.[5] The next season Peoria led the towns on the middle Illinois with 30,000 hogs,[6] while Chicago killed only about 20,000.[7] From that time, however, the business increased rapidly in Chicago, and by 1861-1862 it was the leading slaughtering and packing center in the United States, killing over twenty times as many hogs as it had ten years before.[8] This rapid rise of Chicago to pre-eminence as a packing center was due largely to the great railroad mileage that, beginning in the decade 1850-1860 (Figs. 43 and 44), became tributary to the city.[9] Greater economy in manufacture was possible in a small number of large establishments. Accordingly the development of railroad transportation contributed to the decline of the industry in the towns on the middle Illinois river, except in the case of Peoria.

Manufacture of flour.—The early manufacture of flour beyond the needs of local consumption probably has its explanation in the desire to reduce the surplus grain to the smallest possible compass in order to transport it profitably to the distant markets. The same considerations had led to the rather extensive manufacture of flour still earlier in Ohio.[10] One of the first flouring mills in that part of the State was built in 1830 on Kickapoo creek, near Peoria (p. 81). The product, beyond that required in the vicinity, was sent on large flat boats to New Orleans, where it was sold from $1.37 to $1.50 a barrel.[11] Peoria had four mills in 1850, which that year exported nearly 34,000 barrels of flour valued at about $152,000.[12]

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[1] Illinois in 1837, p. 96.
[2] History of Peoria County, p. 543.
[3] Princeton, however, is credited with killing 3,700 hogs in 1849-50; Western Journal, V. 3, p. 410.
[4] Peoria appears to have first tried the experiment of summer packing in 1872. (Third Annual Report to the Peoria Board of Trade, p. 21.)
[5] Lacon, 11,500; Chicago, 11,500; Peoria, 21,000; Pekin, 26,000. (Western Journal, V. 3, p. 410.) These figures are only approximate, though the relative importance of the industry in the several towns is correctly stated. Somewhat different figures are given, for example, in Western Journal, V. 6, p. 191.
[6] Western Journal, V. 6, p. 191.
[7] Twelfth Census, V. 9, p. 414.
[8] De Bow's Review, Second Series, V. 4, p. 116; Twelfth Census, V. 9, p. 413. Chicago is said to have commenced killing cattle in 1832 (Parker: Growth of Illinois and Chicago, p. 11), and seems to have led in the slaughtering and packing of cattle by the early fifties. (Curtiss: Western Portraiture, p. 51; De Bow's Review, Second Series, V. 4, p. 116.)
[9] Twelfth Census, V. 9, p. 414.
[10] Eighth Census, Agriculture, p. cxxix, cxxx.
[11] Gould's Peoria Directory, 1880-1, p. 5.
[12] Idem; History of Peoria County, p. 452.

Manufacture of Whiskey.—The problem of marketing the surplus corn was solved in part by the manufacture of whiskey, which carried the crop in small bulk with large value. Pekin had two steam distilleries in 1837;[1] Peoria built one that proved a great success in 1844.[2] Three years later Peoria exported 4,500 barrels of whiskey,[3] and in 1850, 5,685 barrels, worth nearly $57,000.[4]

As already indicated, the development of manufactures in the region was characterized in the earlier years by relatively small establishments in all of the towns, at least all situated upon the river. Pekin illustrated typically the manufacturing interests of these places. In 1837, when its population was only about eight hundred, it had two slaughtering and packing houses, a steam flouring mill, a steam saw mill, and two steam distilleries.[5] The census of 1860 shows that manufacturing interests were still widely distributed.[6] The concentration then in progress continued rapidly, however, until today manufacturing within the area is confined almost entirely to Peoria and Pekin.

THE GREAT PEORIA INDUSTRIES.

General advantages of Peoria as a manufacturing center.—The extensive development of manufactures in Peoria was favored by (1) the location of the city; (2) its transportation facilities; and (3) an abundant supply of cheap coal. (1) Peoria is centrally located with reference to the Illinois valley and the State, in the midst of an agricultural area of unsurpassed fertility. (2) The location and commercial importance of Peoria insured it good railroad connections. It had three railroads in 1860 (Fig. 44). The number had grown to ten in 1875,[7] with nearly one hundred freight trains daily shortly after.[8] Twelve railroads now focus on the city[9] from all directions, like the spokes of a wheel. The competition of the railroads, and particularly the wholesome influence of the Illinois river (p. 108) have secured Peoria low freight rates. These transportation conditions have facilitated both the collection of the surplus grain of the surrounding area, and the distribution of manufactured commodities. (3) One of the greatest advantages Peoria has possessed in the development of its manufactures has been cheap coal. During the period of the establishment of the great industries it was brought to the city in wagons and sold at 7 to 8 cents a bushel, or at $1.50 to $2.00 a ton.[10] Indeed, it was claimed that

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[1] Illinois in 1837, p. 125.
[2] Ballance: History of Peoria, pp. 135-136.
[3] Western Journal, V. 1, p. 113.
[4] Drown: Record and Historical View of Peoria, p. 144.
[5] Illinois in 1837, p. 125.
[6] The manufactures of Putnam County were reported at $38,759; those of Bureau at $125,653; Marshall, $546,700; Woodford, $224,234; Peoria, $4,930,746; Tazewell, $527,655. (Eighth Census, Manufactures, pp. 84, 109.)
[7] Sixth Annual Report of Trade and Commerce of Peoria, p. 53.
[8] History of Peoria County, p. 530.
[9] Thirty-sixth Annual Report of Trade and Commerce of Peoria, pp. 56-57.
[10] Drown: Record and Historical View of Peoria, p. 144; Hunt's Merchants' Magazine, V. 41, p. 696; Third Annual Report to the Peoria Board of Trade, p. 10; Gould: Peoria Directory, 1880-1, p. 7.

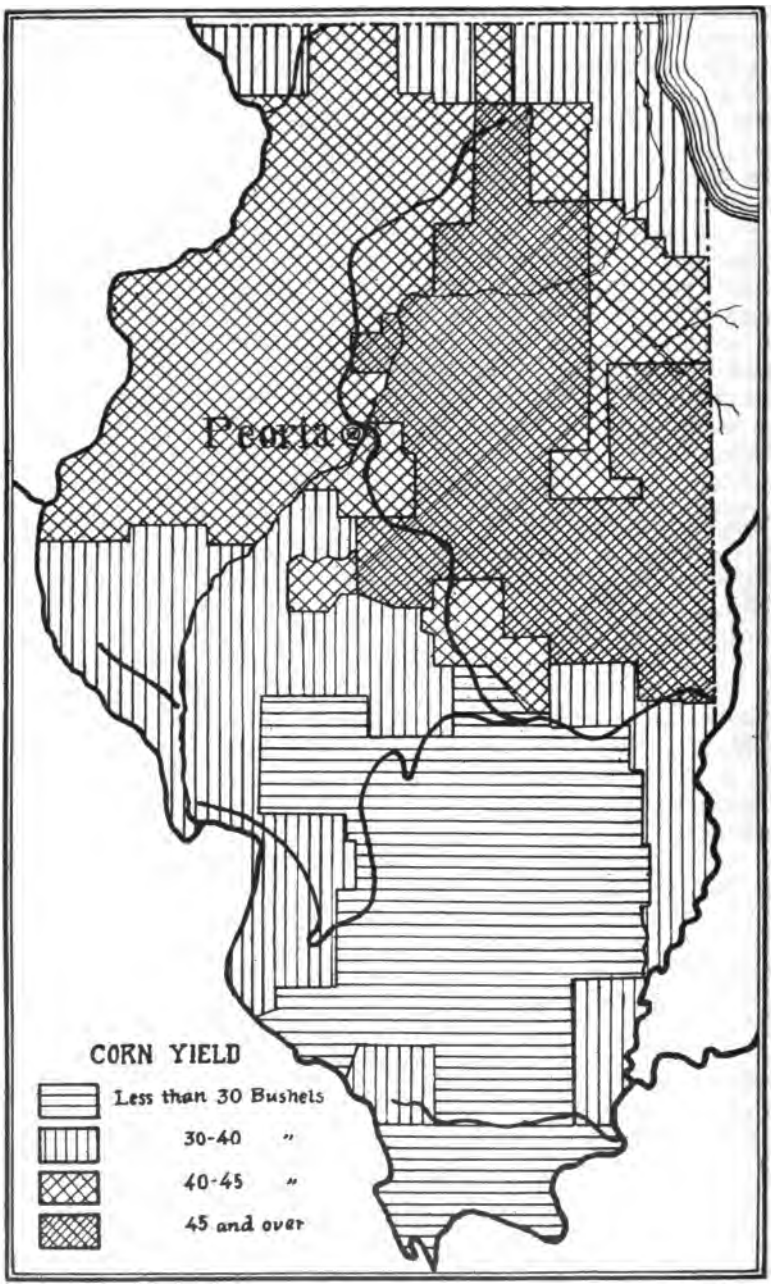

FIG. 45. Map showing the yield of corn per acre throughout Illinois.

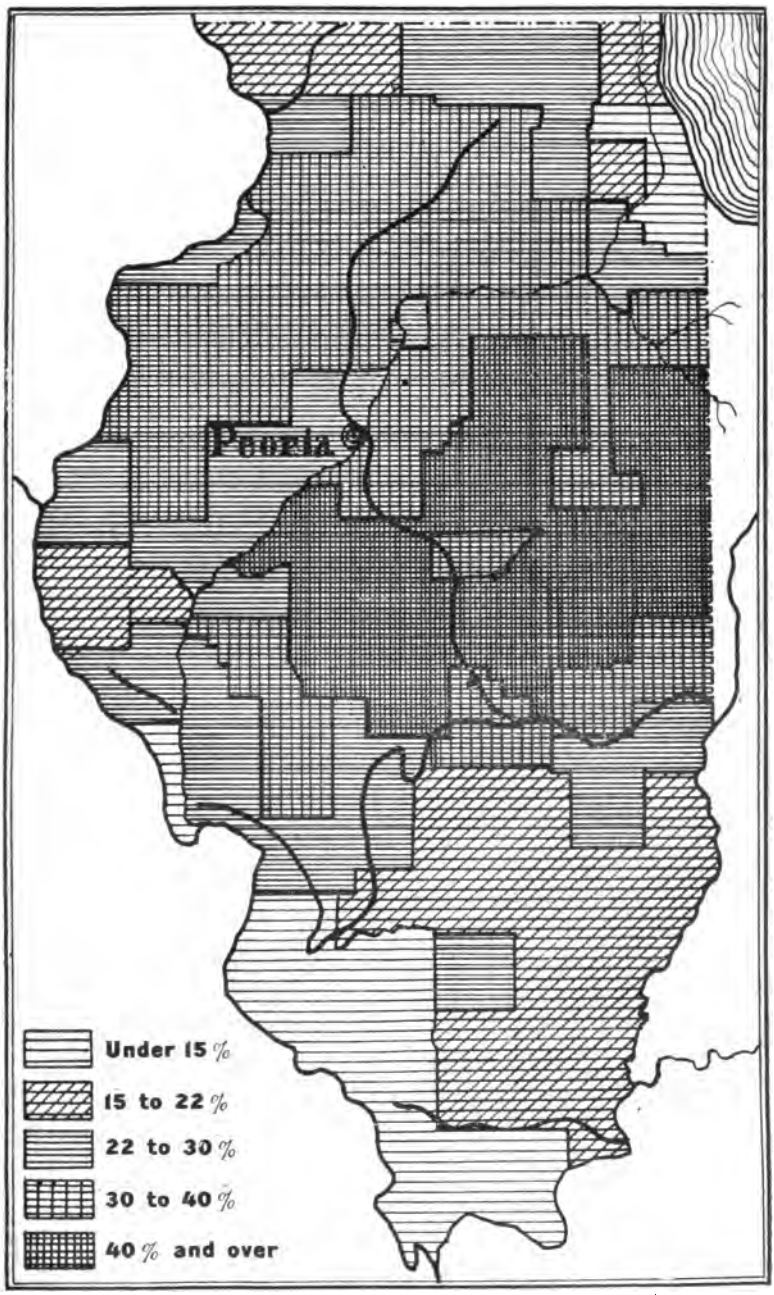

FIG. 46. Map showing the percentage of the total area which is devoted to corn culture throughout Illinois.

coal could be mined and marketed cheaper at Peoria than at any other place in the State.[1] It was used near Peoria from an early date.[2] As the coal occurs in essentially horizontal beds, which outcrop on the sides of various ravines, no special skill or knowledge was required to obtain it, and the simplest methods of drift-mining were followed.

Corn products.—The distinguishing manufacturing industry of Peoria has long been the distilling business, and the glucose industry is now second in importance.[3] For the manufacture of its corn products, Peoria has, in addition to the general advantages noted above, a central location in the corn belt of the State. Figure 45 shows the corn yield per acre throughout the State, and indicates clearly the advantageous position of Peoria in relation to the areas that produce over forty bushels to the acre. The control of the corn yield by the several drift areas, whose borders are indicated by the irregular, heavy lines is very striking.[4] Figure 46 shows the percentage of the total area which is devoted to corn culture throughout the State, and emphasizes the favorable location of Peoria with reference to the areas of higher specialization. Some of the lines bordering the drift areas have less importance than on the preceding map, while others are of equal significance. The importance of Peoria's favorable position on the corn maps will be appreciated when it is stated that the distilleries of the Peoria Internal Revenue District used 5,809,170 bushels of corn in the year ending June 30, 1906.[5] This means 464 acres of corn each week day of the year (counting forty bushels to the acre.)

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[1] History of Peoria County, p. 266.

[2] Probably the first coal discovered in the United States was found in the vicinity of Peoria in 1673. The soldiers stationed at Ft. Clark found coal of good quality on the banks of Kickapoo creek about a mile above its mouth, which they used for fuel. (Beck: Gazetteer of Illinois and Missouri, p. 146.) Illinois valley coal was described in 1823 as very abundant, and valuable because of the scarcity of timber. (Idem, p. 18.) In 1837 it was hauled by wagon one to three miles into Peoria where it was generally used for fuel and sold for 12 cents a bushel. (Illinois in 1837, p. 96.)

[3] Census Bulletin 52, p. 29.

[4] The area of heaviest yield (forty-five bushels and over per acre) coincides essentially with the Wisconsin drift, the boundary of which is indicated on the map by the heavy line which crosses the Illinois river at Peoria. Save in the northeast, the soils of the Wisconsin drift are dominantly dark brown silt loams, and over large areas in the earlier Wisconsin area, black clay loams. (University of Illinois Agricultural Experiment Station, Bulletin 123, pp. 220, 233.) These soils are in general rich in nitrogen and phosphorus (Idem, pp. 222, 233) and are of great fertility. The former type particularly has great capacity to absorb and hold water from heavy rains, later delivering it as needed to growing crops (Idem, p. 222). The black color of the second type is due to the high content of humus, a consequence of the very flat topography of the inter-morainic tracts where it occurs, and the resulting poor drainage. The imperfect natural drainage, however, has required extensive ditching and tiling. The lower yield in the northeastern part of the Wisconsin area near Lake Michigan is due to the influence of Chicago and its suburbs, and to the fact that the broad morainic tracts of this section (FIG. 20) are characterized by a yellow-gray silt loam soil much poorer in phosphorus and humus and less fertile than the soils to the southwest. (Idem, pp. 238-239.)

The area between the Illinois river and the irregular heavy line extending from its mouth to the border of the Wisconsin drift is the area of middle Illinoian glaciation, while to the south of the irregular line the drift is lower Illinoian. The former usually has a brown silt loam of the general type described above, although because of its greater age and the better development of drainage lines, it is often somewhat poorer in nitrogen and phosphorus (Idem, p. 222). It yields in general more than thirty bushels of corn to the acre. The lower Illinoian area has a gray silt loam soil over large areas (Idem, p. 210). It contains less than one-half as much nitrogen and phosphorus as the black clay loams of the early Wisconsin area (Idem, p. 197), and is of relatively inferior quality, producing less than thirty bushels of corn per acre. The greater yield in the eastern part of this area is probably due to the bottom lands of the Wabash river. North of the Illinois river the upper Illinoian drift usually has a relatively fertile brown silt loam soil of the type already described (Idem, pp. 220, 222). The principal upland soil of the neighboring Iowan drift is a sandy loam (Idem, p. 222). The combined area produces forty to forty-five bushels of corn per acre, except in the broken, hilly land of the southern part. The heavy lines crossing the southern end of the State, the lower part of the peninsula between the Illinois and Mississippi rivers, and the northwestern corner of the State, separate glaciated from unglaciated areas. The latter are in general relatively infertile.

[5] Annual Report Commissioner of Internal Revenue, 1906, p. 62.

The beginnings of the distilling industry in Peoria have already been noted (p. 111). The business had become the leading manufacturing interest of the city by 1859-1860.[1] In 1864 there were no less than twelve distilleries within the city, and several others in the vicinity. These twelve distilleries produced over 38,000 gallons of whiskey daily, and used 10,500 bushels of grain and 5,250 bushels of coal.[2] The industry was prostrated for a time in consequence of the passage of the internal revenue law of 1864, and the growing dependence of the city upon it was painfully illustrated.[3] The business revived with the reduction of the tax, and in 1870 there were eight distilleries again in operation.[4] From then on the industry grew rapidly.[5] There were eleven distilleries in 1879,[6] and the output was over three times as great as that of 1870.[7] Peoria had become the leading distilling city of the United States.

The United States in 1900 produced distilled liquors to the value of $63,496,208. Of this Peoria produced $26,792,354, leading its nearest competitor by over $10,000,000.[8] In 1905, the Peoria product reached $42,170,815. This formed 77.9 per cent of the total for the industry in the State, and represented an increase in value of 57.4 per cent in five years.[9] It formed, furthermore, more than 69 per cent of the product of all Peoria industries. The internal revenue collections on distilled spirits in the Peoria district amounted to over $33,000,000 for the year ending June 30, 1906. This was over 63 per cent of the total internal revenue taxes paid by the State, and greatly in excess of those collected in any of the other sixty-five collection districts of the United States.[10] The fact of chief importance here is that Peoria was led to specialize to such an extent in the liquor industry, and attained leadership in the United States in this particular business, because of the geographic conditions discussed above.

The manufacture of glucose, begun in the United States about 1870, is now practically confined to Illinois.[11] Peoria built its first factory in 1879,[12] and the following year used 7,500 bushels of corn daily in the making of glucose and grape sugar.[13] As already indicated, the industry has come to hold second rank among the manufacturing interests of Peoria, but definite statistics regarding it are not available.[14] Starch has been manufactured on a fairly large scale in the past in Peoria,[15] but is not mentioned in the 1905 census list of industries for the city.[16]

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[1] History of Peoria County, p. 553; Eighth Census, Manufactures, p. 101.
[2] Ballance: History of Peoria, pp. 136-137.
[3] Idem, pp. 138-140; Gould: Peoria Directory, 1880-1, pp. 5-6.
[4] Gould: loc. cit.
[5] Porter: The West in 1880, p. 538.
[6] History of Peoria County, p. 535; Gould: loc. cit.
[7] Porter: loc. cit.
[8] Twelfth Census, V. 8, p. 1069.
[9] Census Bulletin 52, p. 29.
[10] Annual Report Commissioner of Internal Revenue, 1906, pp. 1-2, 130-131.
[11] Special Census Report on Manufactures, 1905, Part I, p. cxxxviii.
[12] History of Peoria County, p. 552.
[13] Gould: Peoria Directory, 1880-1, p. 6.
[14] Census Bulletin 52, p. 29.
[15] Hunt's Merchants' Magazine, V. 41, pp. 690-691; Ballance: History of Peoria, p. 146; History of Peoria County, pp. 554-555.
[16] Census Bulletin 52, pp. 48-49

Agricultural Implements.—Next to the making of the two great corn products, distilled liquors and glucose, the manufacturing of agricultural implements is the leading industry of Peoria. Its importance is due chiefly to the great demand for implements existing in the agricultural region surrounding the city. The industry always tends to establish itself near its chief market, because of the high freight rates charged on its products, many of which occupy much car space.[1] Peoria is also favorably situated with reference to the iron manufacturing centers near the end of Lake Michigan, and, by way of the lake, with reference to the hardwood forests of Wisconsin and Michigan. In 1890, the agricultural implements made in Peoria were valued at $519,611 and constituted only 0.9 per cent of the industries of the city; in 1900, the product was valued at $2,372,329, making 4.9 per cent of all industries.[2] In the latter year, Peoria ranked fifth among the cities of the United States in the industry.[3] The principal implements made, reflect the dominant interests of the tributary agricultural area. They are corn planters, grain drills and sowers, listers, cultivators, equalizers, harrows, plows, stock cutters, and harvesters, besides many miscellaneous implements.[4] In earlier days, the country about Peoria depended upon Pittsburg for its few agricultural implements.[5] The industry was inaugurated at Peoria with the manufacture of plows in 1843, and proved very successful. Before 1859 the city was making 10,000 plows per year. The original plant made in 1869, 3,000 plows and about 1,200 cultivators. The second plant established made 20,000 plows in 1870. Peoria implements found a market westward to the Pacific.[6]

Slaughtering and meat packing.—The fourth industry in importance in Peoria is that of slaughtering and meat packing. Its early development in the region and its decline outside of Peoria have already been discussed (pp. 109-110). It continued of importance in Peoria because of its good railroad facilities and because of the distilleries. It was found profitable to use the refuse of the grain after its use in the manufacture of whiskey, in fattening cattle and swine. In 1905, the value of the products was $1,480,398.[7] In addition, cattle and swine are fattened here and then shipped east. Peoria is also an important trans-shipment point for live stock. Great numbers of cattle and swine are collected from the surrounding country, fed, watered, assorted, etc., and reshipped. These promptly became important activities in Peoria upon the development of its railroad connections.[8] The Peoria Union Stock Yards were opened about 1877.

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[1] Twelfth Census, V. 7, p. cxci.
[2] Idem.
[3] Idem, p. cxc. It was outranked by Chicago; Springfield, Ohio; Racine, Wisconsin; and South Bend, Indiana, named in order of importance.
[4] Twelfth Census, V. 10, p. 350.
[5] Ballance: History of Peoria, p. 125.
[6] Ballance: History of Peoria, pp. 125-127; Western Journal, V. 2, p. 268; Hunt's Merchants' Magazine, V. 41, pp. 689-690; History of Peoria County, p. 555
[7] Census Bulletin 52, pp. 48-49
[8] Sixth Annual Report of Trade and Commerce of Peoria, p. 11; History of Peoria County, pp. 541, 542; Gould: Peoria Directory, 1880-1, p. 6; Porter: The West in 1880, p. 538.

Other industries.—It will be impossible to interpret here all the remaining industries of Peoria. Cooperage is fifth in importance, and completes the list of manufactures, the value of whose products exceeded $1,000,000 in 1905. It is dependent chiefly on the liquor industry.

The decline in the milling business is one of the more interesting facts in connection with the minor industries. Flour was one of the leading manufactures of the earlier period and certain facts suggestive of its importance down to 1850 have been given (p. 110). The industry continued to grow until 1870. There were then eight large mills in the city, which manufactured 573,500 barrels of flour. This flour was shipped south, east, and even to Europe.[1] From that date the milling interests of the city declined. In 1880, little Peoria flour was shipped out of the State.[2] In 1905 the value of the product was less ($593,527[3]) than in 1855 ($650,000[4]), and only three mills were running. This appears to mean that Peoria found it impossible to compete with flour from the northwest.[5] The local mills no longer control even the home market. Peoria capital and enterprise find more profitable employment in the great industries discussed above, in the development of which geographic conditions give the city distinct advantages.

Aside from the manufacture of grain products Peoria does an extensive business in storing, transferring, and re-shipping grain, especially corn. The first elevator is said to have been erected in 1866.[6] In 1872 there were five, and the business of warehousing grain was described as having become one of the leading interests of the city.[7] As a collecting point for corn, Peoria ranked fourth among the cities of the United States in 1907, being led only by Chicago, St. Louis, and Omaha.[8]

The settlement of Germans in Peoria led to the early manufacture of beer.[9] The product in 1905 was valued at $887,570.[10]

In addition to the manufactures noted above, the census reports nearly seventy distinct industries of varying, but very minor importance.[11] The total value of the products of all manufacturing industries for 1905 was $60,920,411.[12] The value of all industries in 1900 was $48,871,596.[13] The city accordingly gained 24.6 per cent in five years.

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[1] Gould's Peoria Directory, 1880-1, p. 5; History of Peoria County, p. 452. Peoria exported 30,000 barrels of flour to Great Britain in 1872 (Third Annual Report to Peoria Board of Trade, p. 23).
[2] History of Peoria County, pp. 558-559.
[3] Census Bulletin 52, pp. 48-49.
[4] History of Peoria County, p. 452.
[5] The value of the flour and grist mill products of Minnesota was in 1900 14.1 per cent of the total for the United States (Twelfth Census, V. 9, p. 357). The industry centers in Minneapolis, favorably situated with reference to the wheat fields, and having the great advantage of the water power afforded by the falls of St. Anthony.
[6] History of Peoria County, p. 540.
[7] Third Annual Report to Peoria Board of Trade, pp. 18-19.
[8] Fiftieth Annual Report, Chicago Board of Trade, p. 173.
[9] Ballance: History of Peoria, pp. 146-147.
[10] Census Bulletin 52, pp. 48-49.
[11] The more important are in alphabetical order: Bakery products; brooms and brushes; carriages and wagons; cars and shop construction work; copper smithing and sheet iron work; food preparations; foundry and machine shop products; furniture; gypsum wall plaster; lumber products; mineral and soda waters; models and patterns; printing and publishing; saddlery and harness; stoves and furnaces; tinware; tobacco, cigars and cigarettes. (Census Bulletin 52, pp. 48-49.)
[12] Census Bulletin 52, p. 49.
[13] Twelfth Census, V. 8, p. 1001.

MANUFACTURING OUTSIDE PEORIA.

Extensive manufacturing outside of Peoria is confined to Pekin. Its advantages are the same in kind as those of Peoria, though not so great in some particulars. Various corn products are the principal articles made. The value of the products of all its industries was $12,268,021 in 1900.[1]

It seems likely that East Peoria will become an increasingly important industrial center. It is situated directly across the river from Peoria at the mouth of Farm creek valley and upon its fan, which affords an abundance of land for factories. The industries will of course be those of Peoria itself. A zinc plant has recently been established at De Pue, which is expected to give employment to 1,500 to 2,000 men. This promises to transform the place into a thriving little city.

EXISTING AGRICULTURAL CONDITIONS.

Products.[2]—Corn continues to be far and away the most important crop of the area under discussion, as might be inferred from Figure 46. With two exceptions each census has shown the corn yield of the six counties to be more than twice as great as the combined yield of all other grains; once (1880) it was over four times as large. This specialization is largely due to the character of the soil (footnote 4, p. 114) and to the demand for corn by the distilleries and for the fattening of stock, rather than to climatic conditions.

Wheat was at first the second crop and oats third. Since 1860, however, the production of wheat has greatly decreased, the crop of 1899 being less than one twenty-eighth that of 1860. On the other hand the production of oats has rapidly increased, the crop of 1899 being more than thirteen times as large as that of 1860 and over two hundred twenty-seven times the size (in bushels) of the 1899 wheat crop. Oats were first reported as the second crop in the census returns for 1870. Barley, rye, and hay have always been subordinate crops

Certain bottom and terrace lands near Peoria are profitably used for general truck gardening, and the business would probably prove successful over large areas of similar land now of little use. Large quantities of melons for the Peoria market are grown on the more sandy portions of the Chillicothe and Spring Bay terraces. Successful experiments in the growth of small fruits have been made on the hilly ravine land bordering the Illinois valley. This industry also appears capable of extensive development, particularly in the vicinity of Peoria.

Water supply.—With few exceptions the wells of the region terminate in the drift and are supplied by seepage of ground water from the drift. A portion of the rain sinks into the ground, which, below a certain

[1] Twelfth Census, V. 8, pp. 1028-1029.

[2] Agricultural statistics for the area may be found in Seventh Census, pp. 730-731; Eighth Census, Agriculture, pp. 30-37; Compendium Ninth Census, pp. 726-729; Compendium Tenth Census, pp. 760-763; Eleventh Census, Agriculture, pp. 362-363; Twelfth Census, V. 6, pp. 160-161.

level, is full of water. This level (the level of ground water or water table varies from time to time at any given place, and from place to place at any given time. It is higher in periods of heavy rain, and lower during periods of drought. It changes from point to point because of unequal precipitation and for other reasons. To contain water permanently, the bottom of a well must be below the lowest level of ground water at that place; it will then fill with water to the height of the water table in the adjacent rock or earth. Because of the conditions indicated, wells must be sunk to different depths. Ninety-five "deep wells" in Bureau county range in depth from 45 to 412 feet and average 200 feet.[1] The great majority of the wells of the area are much shallower. When an abundant water supply had been obtained upon the upland prairies by wind mills from wells, one of the serious early problems of the prairies was solved. The water table beneath the porous terraces of the Illinois valley is down nearly to the level of the river, to which, accordingly, terrace wells must be dug. The depth of a terrace well, therefore, indicates approximately the elevation of its top above the Illinois. The artesian wells of the area were noted on page 20.

The distribution of land values.—The distribution of land values is determined by various factors, chiefly the character of the soil, the topography, and the accessibility of markets. The typical black prairie lands of the type so long avoided have recently sold for $175.00 to $200.00 an acre, and are sometimes held at even higher figures. The more uneven yellow clay lands nearer the Illinois valley are less valuable, but are variously estimated from $60.00 to $110.00 or more per acre. Several real estate men report these lands to have greater value west of the valley than east of it, and offer an interesting explanation. West of the valley, winter winds are said to blow large quantities of fine material from fall-plowed fields on black prairies to the irregular belt of dominantly yellow clay land east of them, increasing the fertility and value of the latter. On the east side of the valley the situation is reversed, the prevailing winds carrying material from the yellow clay lands near the river to the black prairie farms situated farther back from the valley. Timbered bluff lands range from $20.00 or less an acre, to $55.00 or more. Terrace lands are said to vary from $70.00 or less where especially sandy, to $100.00 or $125.00, particularly near the valley bluffs where they have been enriched by wash from the uplands. Bottom lands vary greatly in value. Many swampy tracts, subject to frequent inundation, are at present practically worthless. Other higher and drier areas that are suited to truck gardening are of great value.

The figures quoted above have no exact value and serve only to show, in a general way, the striking variations in land values between the several geographic divisions of the area.

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[1] Leverett: Monograph 38. U. S. Geol. Surv., pp. 630-633.

The Hennepin Canal.

Agitation for the recently opened canal from the vicinity of Hennepin to the Mississippi river (Fig. 47) began in 1836.[1] From that time until Congress provided for its construction in 1890, the canal project was frequently before the public. The general assemblies of

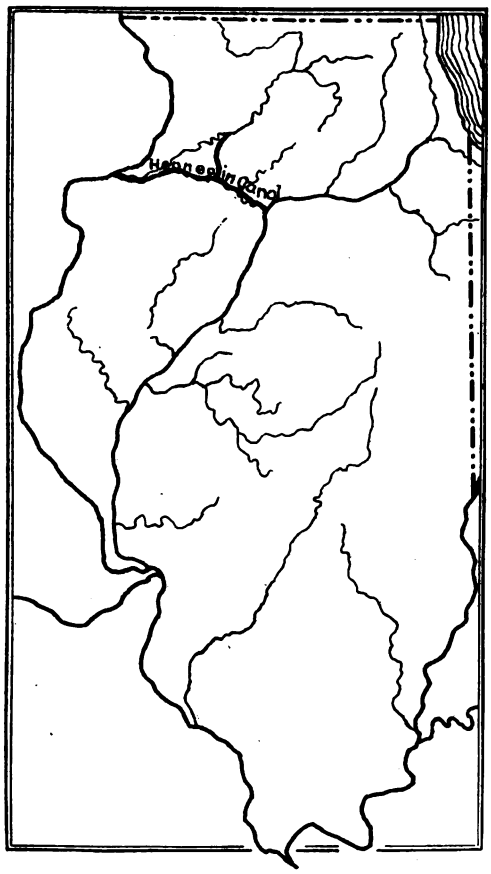

FIG. 47. Map showing route of Hennepin canal.

Iowa and Illinois memorialized Congress for the canal on a number of occasions; it was urged by the boards of trade of various cities; conventions were held to further the enterprise. The government meanwhile made surveys looking to the canal in 1870, 1882, and in 1885-86. A private survey was made as early as 1866.[2]

[1] Matson: Reminiscences of Bureau County, p. 405.
[2] House Executive Documents, 50th Congress, First Session, V. 5, p. 2138.

Various arguments were advanced in favor of the canal,[1] of which the following were chief: (1) It was alleged that railroad freight rates were exorbitant, and that the products and imports of the region, largely heavy and bulky articles, required the cheaper transportation that the canal would itself furnish, and that it would compel the railroads to supply. A saving of about one-half was anticipated in the transportation of grain. (2) An immense grain producing area would be benefited, for the influence of the canal would extend west of the Mississippi into Iowa, south along the Mississippi to a point below Keokuk where the Illinois river would afford the shortest water route to the east, and northward to St. Paul. It would permit the through shipment of grain from the upper Mississippi, for example, to Chicago, where low lake rates were available, thus avoiding the transfer from boats to rail at La Crosse, Savanna, or other river towns. (3) Lower freight rates would enable the northwest to compete with greater success for the European grain trade. (4) It was considered doubtful whether the railroads could long handle the rapidly growing grain trade of the northwest.

The canal was doubtless first suggested by the westward course of the upper Illinois river, and its relative nearness where it turns toward the south, to the Mississippi. The eastern terminus of the canal was accordingly fixed approximately by the great bend of the Illinois and by the valley of Bureau creek, which furnished an easy route by which the canal could reach the summit level to the west.

The Hennepin canal is only seven feet deep, and has inadequate connection with Lake Michigan through the Illinois and Michigan canal. It cannot be of great commercial importance until the "Deep Waterway" is built. Meanwhile it will be simply a local highway, regulating local freight rates.

The Deep Waterway.

The future development of the middle Illinois valley is destined to be profoundly affected by the projected Lake-to-Gulf Deep Waterway. It has been apparent for some years that the federal government must sooner or later create a Deep Waterway from Chicago through the Illinois valley to St. Louis and the Gulf of Mexico. The need for such a waterway has become imperative. It is required alike by inland and maritime commerce. Indeed, the products and trade of the upper Mississippi valley have of late increased so much faster than the transportation facilities of the railroads, that leading railroad officials, formerly the enemies, as a class, of inland waterways, now advocate their improvement to assist in handling the traffic.

The Chicago Sanitary and Ship Canal, opened in 1900 at a cost of about $50,000,000, while built primarily to dispose of the sewage of Chicago, was intended also, as its name implies, to be a link in the pro-

[1] Typical discussions occur in Annual Report Chief of Engineers, U. S. Army, 1883, p. 1780 et seq.; From Lake Michigan to the Mississippi river (pamphlet of Michigan and Mississippi Canal Commission); and Henderson: The Proposed Waterway from Lake Michigan to the Mississippi via the Illinois and Mississippi Canal (World's Columbian Water Commerce Congress pamphlet).

jected Deep Waterway. It was provided by state law that whenever the United States completed the waterway to St. Louis, it should be given control of the Chicago canal for navigation purposes.[1] It was estimated in 1905, following a federal survey of the Illinois river, that it would cost about $23,500,000 to open a fourteen foot channel from the Chicago canal at Lockport to the mouth of the Illinois river.[2] Chicago has accordingly already expended more than two-thirds of the sum required for the improvement as far as the Mississippi river. The conditions of modern commerce, particularly the fact that the cost per ton for transportation decreases as the size of the cargo increases, thus inviting increasingly large boats, render any such depth of water as that afforded by the Illinois and Michigan canal, the Hennepin canal or the Illinois river, wholly inadequate. A *deep* waterway is required.[3] A channel depth of fourteen feet has been proposed because the work for such a depth can be done economically, because the supply of water necessary to it can be provided easily, because it was thought that a similar depth could be counted on during most of the year in the Mississippi river below St. Louis, really the outlet of the canal, and for other reasons.[4] Such a depth will not accommodate the most important lake traffic, for two-thirds of the lake trade of Chicago, for example, is done with boats drawing more than fourteen feet of water, and the trade of the new Illinois waterway will probably be carried on in specially constructed steel barges, drawing twelve to thirteen feet of water when loaded, and towed in groups by powerful tugs.[5]

The nature of the demand for the Deep Waterway and its probable importance may profitably be indicated in more detail.[6]

(1) Although trade in the Mississippi basin now moves largely along east and west lines, north and south traffic promises to assume immense proportions in the immediate future. The northern interior requires, in increasing quantity, southern cotton, tobacco, sugar, rice, lumber, etc. The rapidly developing new South will look to the lake and prairie plains and their cities for constantly increasing quantities of cereals, meat, iron and steel, machinery, wagons, wooden ware, canned products, and the like. During the last few years, trade between the North and South has been seriously restricted by increasingly heavy rail rates. It was said in 1906 that there was scarcely a wholesale merchant or manufacturer in the middle west who did not find himself barred by railroad freight rates which were practically prohibitory, from the territory south of the Ohio river. The only relief appears to be in the improvement of the waterways.[7] The Deep Waterway would

[1] Memorial of Trustees of Sanitary District of Chicago to Congress, p. 5; House Document 263, 59th Congress, First Session, p. 10.
[2] House Document 263, 59th Congress, First Session, p. 19.
[3] Report Deep Waterway Committee of Chicago Commercial Association, June, 1906, p. 20.
[4] Memorial of Trustees of Sanitary District of Chicago to Congress, p. 4. The maintenance in the lower Mississippi of the depth indicated appears to be one of the most serious phases of the problem.
[5] House Document 263, 59th Congress, First Session, pp. 13,14.
[6] This subject is discussed among other places in the following: Report of the Deep Waterway Committee of the Chicago Commercial Association, June, 1906; Report of the Federal Survey for a Deep Waterway, in House Document 263, 59th Congress, First Session; Memorial of Trustees of Sanitary District of Chicago to Congress; Report of Internal Improvement Commission of Illinois, February, 1907; Illinois Waterway Report of Internal Improvement Commission of Illinois, March, 1909; Cooley: Lakes and Gulf Waterway.
[7] Report of Deep Waterway Committee of Chicago Commercial Association, June, 1906, p. 17.

doubtless exert a wholesome influence on railroad charges to the south. Furthermore, the traffic in question is for the most part in bulky, non-perishable commodities that seek water transportation because it is cheaper, and because they generally constitute through shipments.

(2) The Deep Waterway is demanded for the trade of the northern interior with the countries to the south and across the Pacific, a trade which will reach a volume, following the opening of the Isthmian canal, at which present figures but vaguely hint. At present, goods from the upper Mississippi valley destined for Mexico frequently go by way of San Francisco, or by way of New York. Shipments to Central America or western South America usually go by rail to New York, and thence to Panama. The fact that such goods must go half way across the continent by rail to tidewater, imposes a heavy handicap upon the merchants and manufacturers of the middle west seeking to develop these foreign markets.[1]

(3) Such a Waterway would furnish the ship yards of the Great Lakes with an outlet to the sea.[2] This would enable them to build vessels for the ocean trade, for they already possess unrivaled advantages in the way of iron, coal, and timber.[3]

(4) The Deep Waterway would enable the smaller vessels regularly engaged on the Great Lakes to seek winter employment in the coasting trade.

(5) Such a route would be open considerably longer each year than the Great Lakes, or any Deep Waterway that could be provided leading eastward from them to the coast.

(6) The Deep Illinois Waterway would connect the largest cities of the interior, Chicago and St. Louis, and increase the trade between them, which recently amounted by rail to but little over a million tons a year.[4]

(7) The additional supply of water from Lake Michigan necessary to secure a depth of fourteen feet in the Illinois river (some 10,000 cubic feet per second) would create a great amount of water power (estimated at 173,000 horse power[5]) in the upper Illinois valley, where locks and dams must be used. Coupled with favorable transportation conditions, this power would doubtless lead to the extensive development of manufacturing.

(8) By drawing widely separated sections closer together commercially, the Waterway would also acquire political importance, strengthening the political ties uniting the states, and cementing friendly relations with the foreign countries to the south. In the unlikely event of war upon the northern frontier, furthermore, the smaller boats of the navy could pass from the Gulf to the Lakes.

It is evident that the projected Deep Waterway across Illinois will be of national importance, for its benefits will not be confined to the immediate section through which it runs. They will extend to all points

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[1] Report of Deep Waterway Committee of Chicago Commercial Association, June, 1906, p. 31.
[2] House Document 263, 59th Congress, First Session, p. 15.
[3] Report Deep Waterway Committee of Chicago Commercial Association, June, 1906, p. 27.
[4] Idem.
[5] Report of Internal Improvement Commission of Illinois, February, 1907, p. 57.

tributary to the Great Lakes, the Mississippi and its navigable tributaries, and the Gulf Coast. It is likely to be the most important link in any great related system of inland waterways which may be developed in the future.

The Deep Waterway will be a principal factor in the future economic history of the middle Illinois valley, which will be benefited quite as much as any other district along the lines already suggested. A development unprecedented in the region may confidently be expected in agriculture, commerce, and manufacturing; the rapid and complete exploitation of the coal deposits will be brought about; and the now stationary river towns will be restored to importance, and a new period of growth inaugurated. With the Waterway added to its other advantages, Peoria will probably find it easy to maintain its position as the second city of the State.

It should be remembered that the Deep Waterway has been rendered possible and practicable by physiographic processes, and that all the results it produces will look back to those processes as fundamental influences.

SUMMARY.

The salient points in the preceding discussion may be briefly summarized as follows: (1) Geographic conditions determined the fact that the middle Illinois valley was settled first and slowly by southerners, and later and rapidly by northerners, by whom its life was dominated. (2) The early settlers were distributed with reference to geographic features. They established themselves within easy distances of the Illinois or a navigable tributary, usually avoided the unhealthful flood-plain, frequently chose terrace sites, and, on the uplands, clung for years to the edge of the timber. (3) When the woodland was taken up, new comers were forced out upon the prairies. They occupied the smallest prairies with the best soil and water supply first, gradually filling them from their margins inward. (4) Geographic conditions determined the occupations and mode of life of the valley. The settlers were forced to undergo for years many privations. The growing of corn and the raising of live stock were the leading industries. Timber, flour, and meal were among the pressing needs of the pioneer, and flour and saw mills were accordingly among the first improvements. The marketing of produce was difficult. At first the Illinois river was the only outlet, but conditions were unsatisfactory at the down-river cities, and active wagon trade was developed between the northern part of the area and Chicago. (5) Geographic conditions located the valley towns and determined the nature and extent of their progress. For a variety of reasons, Peoria promptly attained leadership. (6) The river was a great commercial highway during the period of the Illinois steamboat, 1835-1855. Its connection with Lake Michigan by the Illinois and Michigan canal, made possible by physiographic processes, marked an epoch in the history of the valley, and modified its life in important ways. (7) Certain disadvantages in the navigation of the

river, for the most part geologically imposed, made it an easy prey to railroad competition, and, save in one or two cases, checked the growth or inaugurated the decay of the river towns. (8) The occupation of the great prairies back from the streams and away from the timber was finally permitted in the decade 1850-1860 by the building of railroads and the introduction of modern farming machinery. (9) The Illinois river and the Illinois and Michigan canal continue to be of great importance to the people of the region as regulators of railroad freight rates. (10) Geographic conditions led to the early development of manufactures throughout the region, and determined their character. Later, they gave Peoria high rank among the cities of the United States in certain industries. (11) Commercial considerations seem about to compel the extensive improvement of the Illinois river, and of its connection with Lake Michigan. This projected Deep Waterway is likely to be one of the largest factors in the future economic life of the region, creating new activities, and stimulating old ones.

In conclusion it may be safely said that geographic conditions have been leading factors in shaping the development of the middle Illinois valley.

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